THE NATURE BOOK

DAFFODILS.

From the Water-Colour Drawing by Beatrice Parsons.

THE NATURE BOOK

A POPULAR DESCRIPTION BY PEN AND CAMERA OF THE DELIGHTS AND BEAUTIES OF THE OPEN AIR

* * *

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A GROUP OF PUFFINS.

A SEA-BIRD NURSERY

Some interesting facts on the domestic life of Sea-birds

By A. J. R. ROBERTS, B.A.

Illustrated with Photographs by the Author

FAR back in the ages when the earth was void, and without form, the elemental wind swept over the heaving waste of waters, stirring them to their depths. On every wave there rode a crest of gleaming white, and the wind caught them up, tossed them hither and thither and breathed life into them. For the sea had responded to the touch of her rude lover, and the children of that embrace were the sea-fowl—wild, restless and elemental as the forces which begat them. Born of the sea, to be the playthings of the wind, they partake in greater or lesser degree of the nature of one or the other parent. Some, long and lever-winged, light as foam and strong as the storm, have made their home in the air, wheeling, soaring, gliding and wheeling again hour after hour, day after day, living, feeding, and, who shall say, perhaps sleeping, on the wing. Others, boat-like in build, with breast-bone thickened to form a keel and wings short and narrow to serve as paddles under water, spend their life on the ocean following the wandering shoals of fish far out of sight of land and out-matching them in their own element.

Such are the sea-birds for nine months in the year, but they cannot quite dispense with land. Regularly as the seasons, the instinct stirs within them to propagate their own species, and in obedience to the call they journey hundreds of miles unerringly across the trackless ocean, guided by some unknown compass back to the nursery where they, too, were born.

Towards the middle of May you see them streaming in from every hand, dropping exhausted on the cliff-ledges, the boulder-strewn slopes and the stack rocks, till the earth seems covered, the sea dotted, and the air teeming with countless birds. And still they come—snowstorms of kittiwakes, the puffin with his gaudy wedding beak, the grunting razorbill, the snake-necked guillemot, the petrels and shearwaters, the cormorants back to the stench and swelter of their nests, and the hordes of thieving gulls—herring, greater and lesser black-backed—to take toll of their eggs, the hawk of their lives, and the skua to claim tithes of their fishing.

The nursery is generally some inaccessible sea-girt precipice, broken here and there by steep grass-grown slopes, piles of huge boulders affording numberless holes, nooks and crannies—ready-made burrows for the razorbills and puffins. The guillemots line the narrow ledges on the very face of the cliff, laying their solitary egg in places where destruction seems to threaten it every instant, or mass together on the broader benches and the summits of the stack rocks. The kittiwakes form a colony apart, taking advantage of any slight irregularity in the surface of the rock to affix their nest, almost as does the house-martin against a sheer wall. Bits of seaweed, grasses and straws are trodden down and cemented by slime and mud brought up on the birds' feet, till the nest becomes one solid mass adhering firmly to the rock; and there they brood high above the warring of the waves, like so many sculptured saints in natural niches, drowning the monotonous roar of the surf by their incessant wailing cries. Drop a stone over the cliff-side, and immediately the birds sail forth in a dense body on extended wing, then, quickly recovering from their fright they check themselves with much beating of wings, and the pearly grey cloud dissolves into a thousand shimmering units, whirling, rising and falling like an eddy of snowflakes, whilst from every throat there comes the indignant scream "Kitti-wa-ake, kitti-wa-ake!"

MALE RAZORBILL.

Gradually the storm subsides and the birds return to their nests, for they do not willingly quit them for long. Only too well do they know that their larger relatives are more to be feared than any human being, and such is the boldness and greed of the herring and lesser black-backed gulls that I have often seen them swoop down upon some unguarded nest within fifteen yards of me, and, driving their powerful beaks through an egg, carry off their booty to devour at leisure on some dizzy height. To this the photographer owes his opportunity. Creeping from ledge to ledge along the face of the cliff, avoiding any quick or sudden movement, it is not hard to

A CLUSTER OF KITTIWAKES.

obtain a picture, setting up the camera some six feet from the bird.

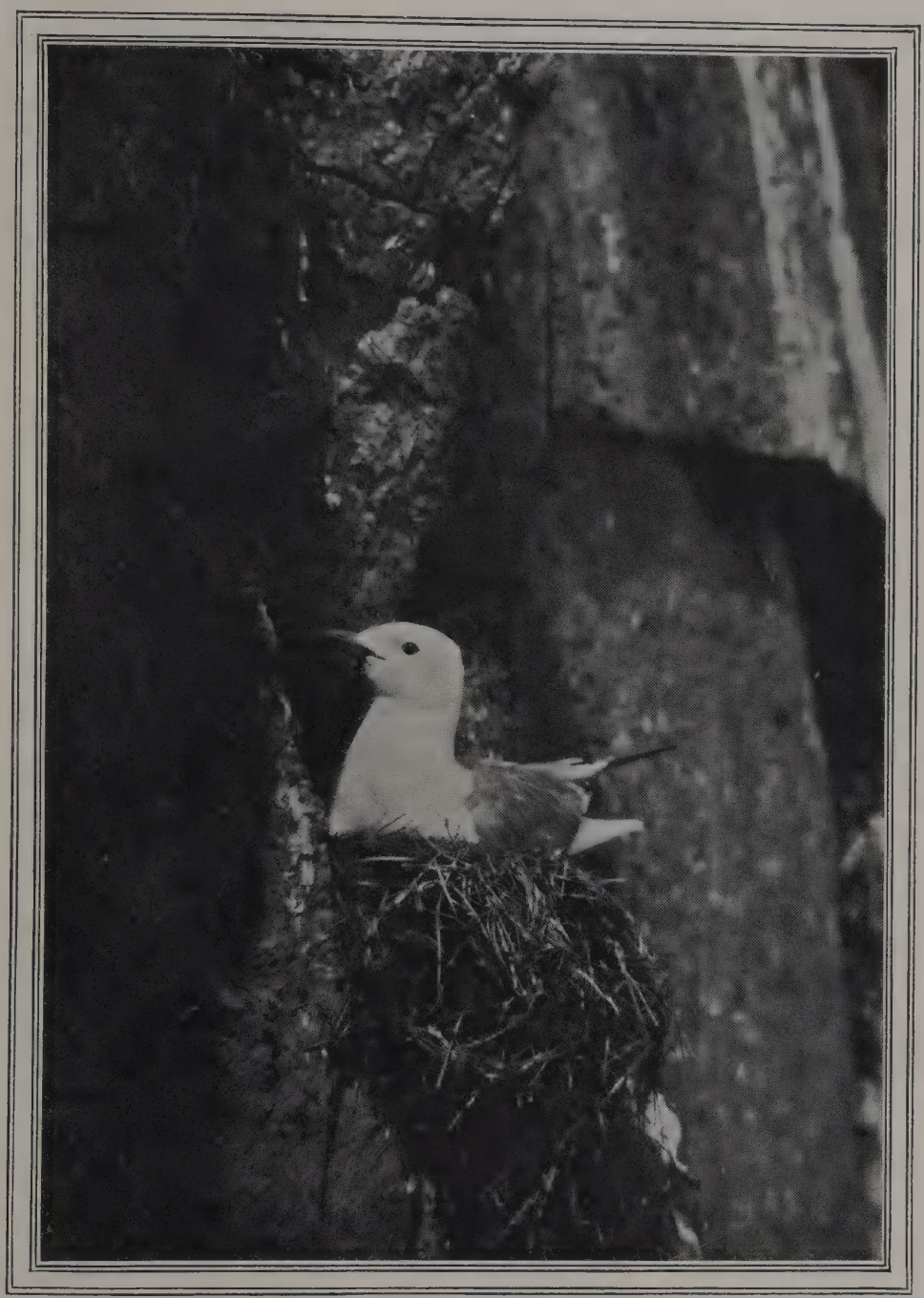
So, too, may he stalk the guillemot; for to the winged poacher the relatively enormous egg is, if anything, a still greater prize. It is intensely interesting to watch these birds from so close a distance that one thinks to read their changing moods in the piercing black eye. No greater contrast to the dainty lover-like kittiwake could well be imagined. Watch them as they sit in rows with white breast turned to the cliff so that their drab-coloured backs may render them less conspicuous to enemies from the sea, craning their snake-like necks this way and that, eyeing you now from one side now from the other, curious of their neighbours' affairs, anxious yet reluctant to go, and you will begin to recast your ideas on the possibilities of bird anatomy and perpetual motion. The one fixed point is where the body touches the egg, for the female plucks a patch bare of feathers between the thighs so as to bring the greatest heat to bear on incubation, and sits astraddle with the egg between her feet. The egg is deep blue, cream or even white in ground colour, blotched, streaked or scribbled over with bold black markings. No two are alike, but all are pear-shaped —a provision which causes them to roll in a circle when set in motion, though often the ledges are not sufficiently wide to admit of this manœuvre. Numbers are destroyed by sudden gusts of wind, and yet more are literally kicked off by the birds themselves when, suddenly alarmed, they attempt to leave in a hurry, and break with a sickening hollow squelch on the rocks perhaps two hundred feet below.

The guillemot is reputed to be a some-

what silent bird, and it is this silence, combined with the constant restlessness, that heightens the almost uncanny impression it leaves upon one's mind. Yet when they are collected in vast numbers on some stack rock there is a continuous murmuring hubbub, rising sometimes, and especially at night, to a clangorous roar—like the ground sea, a prelude to a change in the weather.

Returning to the summit of the cliffs one steps into a new world. All is warmth and sunlight, and one gives a slight shudder—a relic of the damp, cool precipices, the cavernous gullies still lying in the shadow. But all is life, too. Hosts of puffins and razorbills bask on the sunny boulders; they crawl forth from their burrows; the air is alive with a stream of birds flying in one vast circle—the constitutional exercise of the puffin city. Some are constantly dropping out, others rise to fill the gaps, and so the stream flows on. Many return from the sea with four or five small fish held crosswise in the beak, heads and tails dangling on either side; others wing their way to the fishing-grounds, and one's eye follows them to the water only to see innumerable specks of black and white bobbing up and down on the waves. Nay, more! Here and there one can see a shadowy form beneath the water, cleaving its way, doubtless, through some shoal of tiny fish; and few, indeed, escape that once feel the pressure of that beak. The profusion of life is bewildering. The birds are all about you as you sit half concealed among the boulders, each apparently the exact counterpart of the other. Then suddenly it flashes upon you that each has its own individuality, thinks its own thoughts, lives its own life. Differences too slight to catch the human eye are all apparent to them—else how account for their behaviour? Half a dozen birds close at hand are basking peacefully in the sunlight. Another joins them; there is plenty of room on that enormous boulder, but seemingly he is not a friend. Instantly a fight ensues. Two birds seize each other with their curious beaks and strain and struggle for mastery, preserving the while the most ludicrous gravity and perfect silence, till one or both fall over the edge and disappear from view.

RAZORBILLS AND PUFFINS.



KITTIWAKE AT HOME

Wonderful that they can find their own nesting hole in that wilderness of tumbled stone; wonderful that they can recognise their mate amongst the teeming throng; more wonderful still that they should distinguish friend and foe—unless the organisation of the puffin city is greater than we suspect. What if the birds nesting in one small area consorted together like neighbours in one street? Then perhaps were the riddle solved.

Yet teeming as the life of the nursery is, it must be as nothing compared with the infinite resources of the sea. All these birds and their young have to be fed for nearly three months on fish caught in the immediate neighbourhood. The cormorant is said to eat considerably more than its own weight of fish every day, and it is certain that puffins, razorbills and guillemots are not far behind. One hesitates to commit oneself to figures, but in some nurseries there are tens of thousands of birds, and the fish mortality during the breeding season must amount to many millions. Yet one rarely sees the birds in any quantity more than five miles from their breeding quarters.

Stragglers, indeed, may be found perhaps twice that distance, but the time required to make the journey is prohibitive when there is a hungry young one waiting in the burrow. The puffin is not an expert flier, nor, indeed, are any of the diving sea-birds. The wings have been reduced to a minimum to allow of their being used in swimming under water, and they often experience a difficulty in rising from a calm sea. With head invariably turned to whatever breeze there is, they flap their way over the water like a frightened domestic duck, and then taking advantage of some tiny wavelet they launch into the air. Then their weight gives them momentum, and they travel at a great pace, making a bee-line for their home. The densest fog causes them no difficulty, though how they take their bearings it is impossible to say. I know one old skipper who steered by their flight against the reading of his compass, and it was not till afterwards that he discovered that the needle was affected by a quantity of iron lying close by on deck.

Then when all the labour of rearing the young is over, they are taken down to the water to receive their education, and, if the parent birds have any power of thought, anxiously indeed must they watch the sky lest in the stress of the gale their weakly young ones are drowned. It is Nature's redressing of the balance, the safeguard against the exhaustion of the food supply, and the relentless ocean taking toll for the harvest it yields.

A. J. R. Roberts.

VEGETABLE GALLS

WHAT THEY ARE AND HOW THEY ORIGINATE

By HAROLD BASTIN

With Photographs by the Author

BY an appeal to the "life history" of the oak-apple Gall-fly, I was able, in a previous paper (p. 693), to show that galls are the direct outcome of insect activity exerted upon the highly sensitive meristem tissue of plants; also, that galls are, in effect, nurseries wherein the earlier stages of the insects are passed in comfort and security. Moreover, we had a glimpse of that amazing phenomenon known as "alternation of generation." But lest the reader should assume that this phenomenon is characteristic of Gall-fly life as a whole, I must enter upon a brief explanation.

Gall-flies must surely be classed among

"BEDEGUAR," OR "ROBIN'S PINCUSHION" OF ROSE.

the most perplexing of all insects from the standpoint of the student. Quite a number of kinds, especially of the numerous species which are associated with the oak tree, have two alternating generations in the course of each twelve months — each generation differing from the one which preceded it, and emerging from a different kind of gall. Moreover, one of these generations is agamic (*i.e.* made up of solitary females capable of virgin reproduction), while the other is sexual, comprising both males and females. These facts were not known to the early naturalists, who gave the insect which emerged from each kind of gall a different name. For example, the wingless agamic female which is bred in the small root galls of the oak was called *Biorhiza aptera*, while her direct offspring (the flies which emerge from the "oak apple") had the name *Biorhiza terminalis* given to them. In order to avoid heaping confusion upon confusion, these separate names are still retained by most writers; but until the tyro fully grasps the facts of the case, this use of one name for the "mother" and another name for the "child" is apt to be very perplexing. Further, the fact that the phenomenon of alternating generations is not exhibited by *all* Gall-flies does not tend to simplify matters. Quite a number of species have only one generation, or brood, in the course of each year, and in such cases the life cycle is usually quite in accord with that of an ordinary insect. Both sexes are represented, the offspring resemble their parents, and only one kind of gall is produced from year to year.

As examples of these "one generation" Gall-flies I may mention three kinds whose galls are commonly found upon the leaves of wild-rose bushes. These galls differ much in appearance, and this is probably because the grubs attack the cell tissue in distinct ways. First there is the familiar "bedeguar" or "robin's pincushion," formed by an insect known as *Rhodites rosæ*. This gall is a kind of community, being made up of a number of cells, each of which contains a grub. It often appears to grow from a twig or stem, but this is apparent only, and consequent upon its great development. Actually, it invariably originates in a leaf, or in leaves—the insect ovipositing in a leaf-bud. The number of cells in these galls varies greatly. Sometimes there are as few as three; while in the case of a very large specimen there may be as many as forty or fifty. The mass of

SECTION THROUGH A SMALL "BEDEGUAR" GALL OF ROSE BUSH, SHOWING GRUBS IN THEIR CHAMBERS. (Magnified.)

cells is entirely concealed under a dense growth of long, many-branched fibres, which possibly represent the abortive attempts of the irritated meristem tissue to develop into leaves. In colour, these fibres are green, pinkish or crimson, and the whole gall is a very pretty object.

"MARBLE GALLS," FORMED BY *CYNIPS KOLLARI*.

The next of these rose-bush galls is that formed by the fly called *Rhodites eglanteriæ*. It is about the size of a pea, greenish ripening to crimson as to colour, and must be looked for upon the under side of the leaves. Each of these galls has only one tenant, except in rare cases where marked distortion suggests that two or more galls have coalesced on account of their juxtaposition upon the leaf. The third gall is formed by *Rhodites nervosus*, and is also found upon the under side of the leaf. But it is perfectly distinct from the kind just mentioned on account of the thorn-like projections which spring from its surface, like the spikes on a mediæval war club. Almost any hedgerow in England will supply specimens of these three galls, so that the reader may readily compare them, and breed from them their respective tenants. In the case of each species the eggs are laid in the spring or early summer, while the galls reach perfection about September. In the autumn, the two unicellular galls fall to the ground, whereas the big "bedeguar" remains on the bush throughout the winter. The grubs pupate within the galls, and the perfect flies emerge the following year, to perpetuate their species (and the respective gall formations) in a perfectly straightforward manner, and without the intervention of a perplexing agamic generation.

The Gall-fly which, in many respects, is at once the most curious and the most interesting of all the species found in England, is the insect which comes from the well-known "Marble Gall," often produced in such numbers upon young oaks, or upon the shoots of pollarded oaks in hedgerows. *Cynips*

kollari is the name bestowed by science upon this Gall-fly, in compliment to the old Continental naturalist, V. Kollar, who first noticed it. Curiously enough, this insect — which had been well known in Europe for very many years—was not observed in England until the year 1834 or thereabout. By some means the fly, or its galls, must have been introduced to this country, and so well did the change suit it that, twenty years later, the species was reported as being abundant in the south-western counties, where it had gained the popular name of "Devon gall." To-day, it may be found in most parts of England and

GALLS OF *RHODITES NERVOSUS* ON WILD ROSE LEAF.

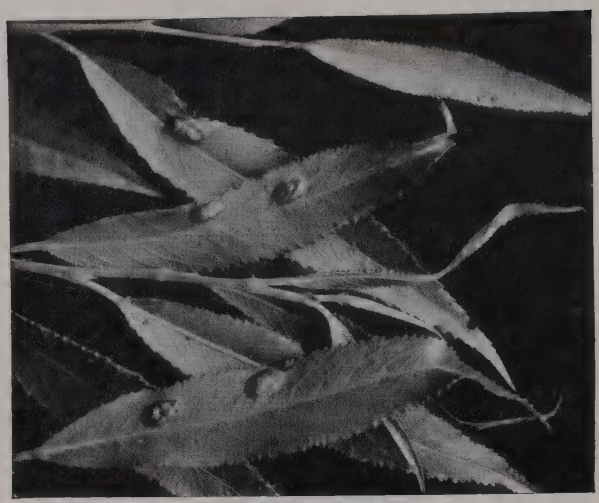
in many parts of Scotland; and its best-known popular title is the "Marble Gall"—a name which aptly describes its appearance.

The Marble Gall-fly is slightly less than one-sixth of an inch in length—that is, from the front of its head to the end of its body. As Gall-flies go, it is a large species. After many fruitless attempts, I succeeded in obtaining a magnified photograph from life of this insect. It is seen resting upon the summit of its gall, close to the hole which it has bored in order to escape. The photograph gives a good idea of the strange "humpy" form of the tiny insect; while the relatively ample wings (they are about 11 millimetres, or not much under half an inch, from tip to tip when extended) are well indicated.

I have already said that the Marble Gall-fly is, perhaps, the most curious of its kind. This estimate is based largely upon the well-nigh incredible fact that every specimen which has ever been seen by naturalists has proved to be a female. Enthusiasts in the past have collected many hundreds of the galls, and examined carefully each insect that emerged from them. But the result of these researches has always been the same. Not a single male has been found. Indeed, it is scarcely too much to affirm that no male of the species exists; that it has become totally extinct.

Now, as this Gall-fly is known to complete only one generation in the year, it is at least conceivable that the species may, in times past, have been "double brooded," producing a sexual generation in alternation with the agamic one. Still allowing our imagination to wander, we may suppose that for some reason quite outside our knowledge, the sexual generation became obsolete, leaving the "lone ladies" of the agamic brood to perpetuate the species. Such a supposition would serve to explain in some measure the amazing state of things which at present obtains. But I must warn the reader that we are now wandering quite outside the region of ascertained fact. All that we really know is that this strange Gall-fly continues year after year, one generation succeeding another, and yet no male individual is known to exist.

GALLS OF *RHODITES EGLANTERIÆ* ON WILD ROSE LEAF.



"HORSE BEAN" GALLS ON LEAVES OF "CRACK" WILLOW, CAUSED BY A SAW-FLY, *NEMATUS GALLICOLA*.

So far I have spoken only of the typical Gall-flies which constitute the scientific family *Cynipidæ*. But galls are also formed by many other kinds of insects, often by species closely related to others which lack the gall-making instinct. Take, for example, the familiar bean-shaped swellings, perhaps one-quarter of an inch in length, and bright scarlet as to colour, which are found so abundantly on the leaves of the "crack" willow. These are the galls of *Nematus gallicola*—a Saw-fly belonging to the same genus as the well-known Gooseberry Saw-fly, which often does much damage in gardens by eating the leaves of gooseberry and currant bushes. This Willow Saw-fly is double brooded; but, unlike the Gall-flies of the family *Cynipidæ*, the individuals of both generations resemble one another, and the galls are identical. Briefly, the life story is as follows: The parent insect of the first generation lays her eggs, by means of a wonderful twin saw ovipositor, within the leaf buds during April and May; and as the leaves unroll, the scarlet gall structures develop. For several weeks each gall is a solid mass of vegetable tissue with the egg lying in a small cavity near the centre. Then the larva hatches and feeds upon the inner portion of the gall, from which, when full fed, it issues and drops to the ground. Here it forms a tiny cocoon of earth grains, becomes a pupa, and ultimately appears as a perfect fly. This happens in August or September, and each newly emerged female Saw-fly oviposits in developing leaf buds, with the result that a second edition of scarlet bean-shaped galls shortly appears; a second generation of grubs falls to the ground to pupate before the approach of winter; and a second generation of Saw-flies appears in the following spring to perpetuate the species during another year.

Many of the true flies (with two wings), the *Diptera* of science, are bred in galls; so also are some of the *Aphides*, or "Green-fly." The caterpillars of at least two moths form galls, one species in the twigs of the white poplar, the other in the twigs of the Scotch pine. Among beetles, the family of the Weevils includes several gall-makers, one of them—the Turnip Gall Weevil—taking rank as an insect injurious to agriculture on account of the damage which it does to root crops. But possibly the best known gall-forming beetle is that pretty little member of the *Longicornia*, called *Saperda populnea*, the larva of which passes some eighteen months within a gall formed in a twig of the aspen poplar—the whole transformation of the beetle occupying two years.

ONE OF THE FEW GALLS FORMED BY A BEETLE.

Section showing interior (with grubs and pupa) of galls of Poplar Long-horn Beetle.

FISHING FOR STICKLEBACK.

POND LIFE—IV

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author

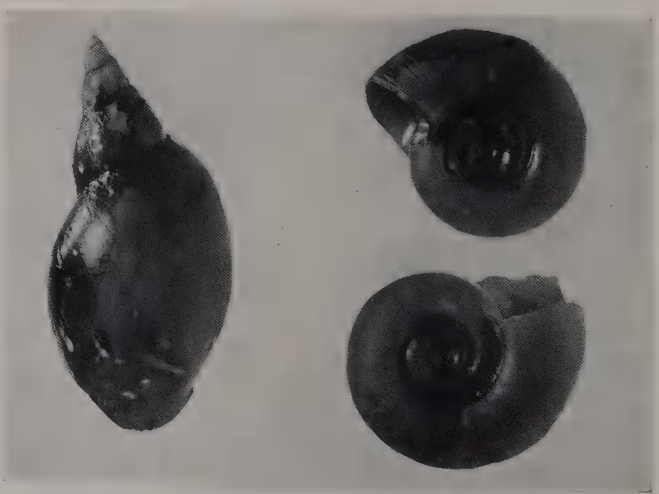
WE now come to the consideration of the larger inhabitants of the pond. One of the most interesting, perhaps, is the Stickleback; that graceful and active little fish beloved of our youthful days. The Stickleback is in many respects a very remarkable fish, and is possessed of considerable personality; in the spring of the year the males become very active, pugnacious, and handsome, their colours being very bright during the breeding season. As the season advances the male fish will swim about amongst the weeds, closely examining each clump, and poke his nose amongst the stones and shingle seeking for a suitable place in which to build his nest; for the Stickleback indulges in the bird-like habit of building a nest for the reception of its eggs or spawn.

The nest is a really remarkable structure. The male Stickleback first makes a small depression in the sand or shingle at the bottom of the pond, and in this places tiny pieces of weed and fibre to make a soft resting-place for the eggs, and over all he spreads a silken coverlet, formed from a natural secretion that the male Stickleback possesses, mingled with particles of fine dust or sand. When the nest is completed, the little Stickleback, in all the glory of his courtship colouring, goes forth to seek his lady-

STICKLEBACK.

love, and lead her to the nest. He soon finds out, however, that the old adage that you may lead a horse to the water but cannot make him drink unless he is so disposed, applies equally well to his mate, who, although quite willing to observe the nest he has built, shows at first considerable reluctance to enter it; and it requires all the perseverance and powers of persuasion of the excited little male fish to induce her to enter and deposit her spawn. At last, however, the female Stickleback goes into the nest, but directly she has placed her spawn therein, she emerges and departs, leaving to her little mate all the anxious and responsible duties of looking after the eggs until the young emerge and can fend for themselves. The father Stickleback takes up the burden of his duties quite cheerfully, and tends his precious charge with the greatest devotion, never straying far from the nest until the young are hatched. All day long he mounts guard, attacking and driving away any unwelcome visitors who attempt to approach, and keeping up a constant and vigorous fanning with his fins at the entrance to the nest, thus causing a continuous current of fresh, well oxygenated water to pass through it.

The Stickleback is not very difficult to keep, and forms a most interesting addition to the fresh-water aquarium, where we have an opportunity of watching its habits at our leisure; and I shall always have a vivid recollection of a particularly bright and pugnacious Stickleback who one spring built his nest in one of my aquaria. He was a handsome, lively little fish, doing combat on all and every occasion with his rivals for the fin and heart of his lady-love. In due course the nest was built, the lady Stickleback, after much fussing, had been induced to enter and deposit her eggs; then after the manner of her kind, she departed to enjoy herself, leaving her mate to his arduous duties. These he fulfilled to the very letter, never quitting his guard over the nest for an instant except to chase away some real or fancied foe. Just before the period of the incubation of the eggs was completed, however, three or four vigorous and highly inquisitive Caddis-worms were unfortunately introduced into the tank. From the moment of their arrival the poor little Stickleback knew no peace, and was indeed almost driven crazy

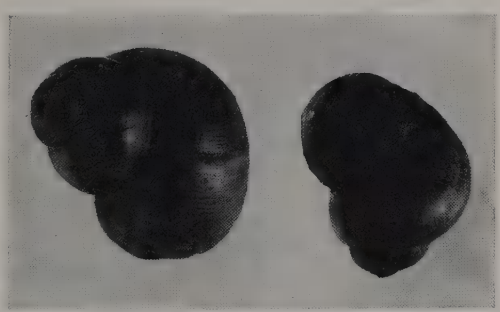


LIMNÆA STAGNALIS AND TWO SHELLS OF *PLANORBIS*.

LIMNÆA AURICULARIA.

by their untiring efforts to explore, or walk over his nest. A Caddis-worm would come crawling along, quite regardless of the rapid, warning movements of the little fish, and blunder right on to the top of the nest. The Stickleback would rush at the writhing Caddis, pull at, and more or less successfully disentangle the obviously protesting insect, haul it clear of the nest, and after administering a good shaking, carry the Caddis off and deposit it at the furthest corner of the tank. Not infrequently by the time the indignant parent returned, he found another Caddis so hopelessly mixed up in the silken threads of the nest, that he had to content himself with making sudden angry little rushes and tugs at the entangled insect until it managed to climb out. It is certain that during the next two or three days every one of those Caddis-worms fell into the nest three or four times, and was hauled out, and across the tank, by the infuriated Stickleback, but they did not seem to gather wisdom by their experience, but blissfully continued to crawl back again to the nest as if they were so many needles attracted by a powerful magnet. At last the tragic end came. In the course of an extra vigorous tussle the nest was torn to pieces, and the eggs dispersed. In an instant the other Sticklebacks, who up to that time had from a distance been passive spectators of the struggle, joined in the fray, and for a few moments a scene of unseemly confusion took place, as they swam rapidly backwards and forwards over the ruins of the nest, greedily devouring the exposed and unprotected eggs. In vain the frantic little father Stickleback tried to drive them off; the commotion only served further to disintegrate the nest and scatter the eggs, and in a very few minutes this little aquatic tragedy was ended.

THE GREAT SWAN-MUSSEL (*ANODONTA CYGNEA*).



SHELLS OF *PALUDINA*.

The Newts, or Efts, are true pond-dwellers, and it is an interesting sight in late spring to watch the females depositing their eggs, one at a time, on the leaves of the water plants. The Newt, after depositing each egg, carefully folds the leaf over, so as to shield the precious egg from observation. Later on the little Newt-tadpoles make their appearance, and are well worth collecting and transferring to the aquarium, for they present a curious appearance, with their plume-like external branchiæ, or gill tufts.

The tadpoles of the common Frog are also to be found in the ponds, and their gradual development is a most interesting and remarkable sight.

Every pond will be found to include amongst its inhabitants a number of shell-dwellers, the different species of Water Snails and Fresh-water Mussels. Though when collecting pond life one is apt to pass these creatures unheeded, they should not be neglected, for a little closer examination will show them to be very remarkable and interesting, and many of them display considerable beauty of colour and form.

Of all the pond snails, probably the one most frequently to be met with is *Limnæa stagnalis*. The shell of this snail is thin, horny, and ovately turreted, with an elongated and sharply pointed spire. It is a handsome creature, and fairly active. It crawls about amongst the submerged weeds, and when undisturbed, with its body fully protruded from its shell, will be seen to have a broad, short head, and somewhat flattened tentacles, near the inner base of which the eyes are placed. This snail may frequently be seen gliding along beneath the surface of the water, shell downwards, and if alarmed it will at once sink to the bottom of the pond. The *Limnæa* deposits its spawn in oblong, transparent masses on water plants and stones. With the approach of severe cold it becomes lethargic and hibernates in the mud at the bottom of the pond.

Limnæa auricularia, although not so common as *Limnæa stagnalis*, is by no means rare; while it has a much smaller shell, the body-whorl is larger than that of *stagnalis*, and has the outer lip reflected.

The most abundant of our native species of *Limnæidæ* is the *Limnæa peregar*. It is a most extraordinarily prolific creature: Dr. Gwyn Jeffreys states that it lays about thirteen hundred eggs in numerous clusters. It is very active in its movements, and is given to creeping up the stems of the aquatic plants and remaining for some time out of the water.

Planorbis is another water snail commonly found in ponds. It is a creature with a very wide distribution, species being found throughout Europe, North America, India, and China. In all there are some 145 species in existence, while about sixty-nine fossil species have been found in the Wealden formation, in company with some seventy species of the *Limnæidæ*, which shows that these pond snails are a very ancient race of creatures. *Planorbis* has a characteristic habit when crawling along, of trailing its shell behind its half-extended body.

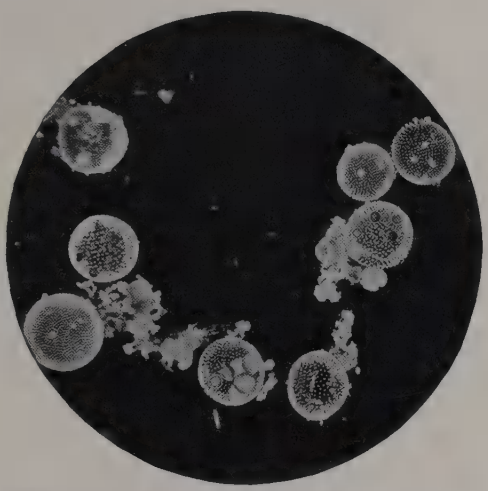
Paludina vivipara also comes of an ancient stock, the fossil remains of its ancestors contributing largely to the composition of the marbles of the Wealden and Purbeck beds. It is a pretty active snail, and has a rather handsome shell, ornamented with coloured bands. A near relation of *Paludina*, called *Bythinia*, is much smaller, and appears to be of a more social disposition, as it may generally be found in considerable numbers. While *Paludina* is viviparous, that is to say, generally brings forth its young alive, *Bythinia* is oviparous, laying from thirty to seventy eggs in a band of three rows on stones or pond plants. The young hatch in about three to four weeks, and take two years to attain their full growth.

The River Mussel (*Unio Margartiferus*), to be found in ponds fed by streams, is particularly interesting from the fact that it is the species that provided the once famous British pearls. The Scotch pearl fishing was at one time an industry that yielded a profitable harvest, and the pearls were usually found in old and somewhat deformed specimens of mussels; round and perfect pearls about the size of a pea were worth from £3 to £4.

Sir R. Redding, in the "Philosophical Transactions, 1693," gave an account of the Irish pearl-fishing, in which he states that the mussels were found set up in the sands of the river beds with their open side turned from the torrent, that about one in a hundred might contain a pearl, and that about one pearl in a hundred might be tolerably clear. It is not very surprising that with such a poor yield the industry has become practically extinct in both countries.

Anodonta, the Swan-mussel, is the largest of our pond and river mollusca, and is a very handsome and interesting creature. When undisturbed it may be seen with

partially opened shells, giving a view of its fringed syphons. It is a very prolific creature, the outer gills of a female having been computed to contain some

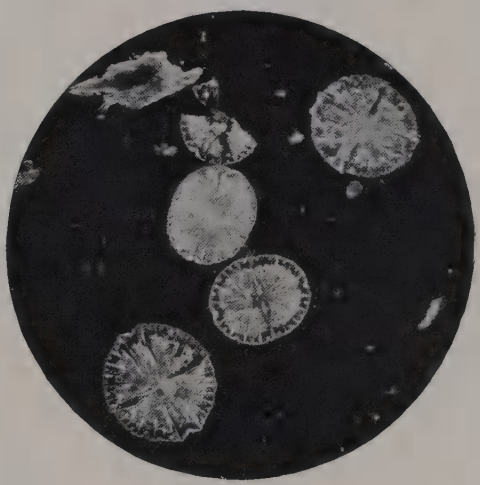


THE BEAUTIFUL AND INTERESTING *VOLVOX GLOBATOR.*

300,000 young shells. Like most of the pond mollusca, the Swan-mussel can boast of ancient lineage, for eight fossil species are to be found in the Eocene formation. Indeed, quite apart from their beautifully formed shells, and varied habits, the pond snails and mussels are an interesting group of animals on account of their forming such a remarkable and striking link with the past geological fauna of our country.

No description of pond life would be complete without a brief reference to some of the interesting and remarkable forms of plant life to be found in that environment. Of the Bladderwort I have already given a description in dealing with the life and habits of the Water Fleas (p. 721). First in interest, on account of its remarkable power of locomotion, is the *Volvox Globator*, which belongs to that debatable group of more or less simple organisms that partake of the characteristics of both plant and animal life. When seen under a moderate magnification the Volvox presents the appearance of a tiny hollow sphere, the outer walls of which look as if formed of a green lattice-work of cells. Careful and critical inspection will also reveal the fact that each cell bears externally a pair of exceedingly delicate hairs or cilia, by means of which the Volvox moves through the water, and that certain cells are of a complex character, in which the young are formed. The Volvox, by means of its cilia, moves through the water with a rolling motion, and at a fairly rapid rate, and is a most beautiful and interesting object to watch by the aid of a low-power object glass under the microscope, when not only its movements can be closely followed, but the growth of the young, and their rolling movements within the parent sphere until its rupture sets them free, may be witnessed.

Next in interest to the Volvox are the Diatoms, those wonderful unicellular plants which secrete an indestructible skeleton of silica, the exquisitely delicate markings of which are the delight of all microscopists. Most of the pond Diatoms have the power of movement, travelling through the water at varying speeds. Exactly how the Diatoms propel themselves through the water is still a debatable subject. They abound in every pond,

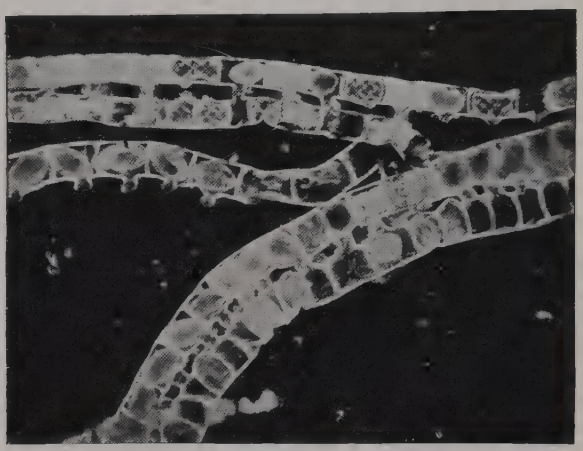


MICRASTERIAS ROTATA.
One of the most beautiful Desmids to be found in ponds.

frequently forming an olive green coating to the stems of the water-weeds, and sometimes quite a thick scum over the surface of the pond.

The Desmids are near relations of the Diatoms, but though they are capable

of independent movement, they do not form silicious skeletons, and they are peculiar to fresh water, while Diatoms abound in both fresh and salt water. Desmids vary considerably in shape and size, and are nearly all very beautiful and graceful of form, one quite common species resembling a tiny green new moon. A very handsome Desmid frequently to be met with in ponds and sluggish streams, is rather like a rosette in shape.



FILAMENTS OF SPIROGYRA IN PROCESS OF CONJUGATION.

A very remarkable and interesting plant which should be collected from the pond in the spring of the year is the Spirogyra. It appears on the surface of the pond as small collections of very fine, almost hair-like stems, more or less tangled together. Under suitable conditions, it is possible to witness the whole process of reproduction in this plant, which is effected by a process called conjugation, and is very interesting. If some of the tangle of Spirogyra be placed in a shallow glass pan of water, the stems, if about to conjugate, will, with the aid of a magnifying glass, be seen gradually to straighten out and draw towards one another. As the stems draw together, the cell walls down the side nearest to the approaching stem will in each case begin to swell outwards until at last they meet and join, giving the two stems the appearance of a miniature ladder. While the cell walls have been growing, the contents of each cell have been passing through a series of changes, until the whole protoplasmic contents has gathered towards the nucleus. When the two opposite cell walls have grown out and united, the nuclei of the two cells either both meet and join in the passage formed by the union of the two cell walls, or one of the nuclei passes through the passage into the opposite cell, where it comes into contact and fuses with the nucleus of that cell. As a result of the fusion of the two nuclei, growth takes place around them, and an oval resting spore is formed, the chains or ladders break up, and the spores sink to the bottom of the pond, where, after a certain period of rest, they start into active growth, each spore becoming the originator of one of the slender Spirogyra stems.

In the foregoing articles I have endeavoured to give some account of a few of the wonders and curiosities of pond life, but it would require more than a dozen volumes of THE NATURE BOOK to do anything like justice to the teeming animal and vegetable life of the pond. Every pond will be found to have its own characteristic forms of life, for variation of locality, vegetation, and water supply, are determining factors as regards the number and species of creatures and plants to be found in each pond. While some forms of life are present in every pond, others are extraordinarily local, but during most months of the year the lover of Nature will find some object of interest in the wayside pool, some beautiful or curious representative of pond life.

F. MARTIN DUNCAN.

A HERBACEOUS BORDER IN GREENWICH PARK.

NATURE "IN TOWN"

GREENWICH PARK

By ARTHUR SCAMMELL

Illustrated with Photographs by W. J. VASEY

THE tide of modern industrialism has long ago flowed over the district of Greenwich, sweeping away much, and disfiguring all; but there are parts of the town where yet the steep and crooked streets, the old Kentish houses set in older gardens, and the dominance of venerable high-set trees, keep for the place something of its ancient and royal distinction.

And that which is true of the town is still more characteristic of Greenwich Park. The steep escarpment, with the great ship-laden river at its feet, the prevalence of large and ancient timber, the stately avenues, the deer, the landscape gardening of the Stuarts, and the architecture of Wren, combine to remind us at least of its former condition as a noble and stately domain, a home for kings rather than the resort of a populace.

It is impossible to separate from the enjoyment felt in this beautiful scene a strong sense of the numerous associations which attach to it. Romans, Danes, Saxons, have left vestiges of their works here, and their ashes still lie beneath the turf. Where is now the Naval Hospital stood the Royal Palace of Placentia, much favoured of Tudor and Stuart

kings. There is the oak, dead now, but green with ivy, under which Henry VIII. is supposed to have danced with Anne Boleyn; and in the hollow of which Queen Elizabeth is said to have supped. Down at the landing-stage Raleigh bridged the pool of Thames mud with his cloak. "Masques and Musique," feasts and revels for kings and courts, Greenwich Fair for the people, and Greenwich Observatory—with its chronological authority, greater, one may say, than that of the sun himself—for the whole world.

After all, however, the chief glory of a park is its trees; and of all the trees, indigenous or introduced to this country, the tree of Greenwich Park, the Spanish Chestnut, is that best calculated to produce, in garden or landscape, the effect of dignity; distinguished by comparative rarity, of slow but not sluggish growth, of lofty and symmetrical stature, with limbs well proportioned to its girth of trunk, with its deeply corrugated bark, set in noble spiral ridges that suggest so much of strength and antiquity; and shapely saw-edged leaf of pure dark green, and firm, yet sensitive texture; the tree well recalls the best associations of its name, the Spaniards' strength and the Spaniards' sombre pride.

The legend which connects the name of Evelyn with the planting of these chestnuts appears to be founded merely on inference—a quite natural inference, however, since he praises the chestnut for "Magnificent and Royal Avenues," a term peculiarly applicable to Greenwich.

The direct reference which occurs in his diary is not to the chestnuts, but to the elms, which he says were planted by his Majesty Charles I. in the year 1644.

There can be little doubt that many of the Spanish chestnuts are of much greater antiquity than this. They probably belong to the period of the enclosure of the Park (by Humphrey Duke of Gloucester), *circa* 1430; whilst the great oak, "Queen Elizabeth's dining room," had no doubt flourished, a stately tree, upon Blackheath long years before that time.

Speaking of the fruit of the chestnuts, Evelyn says: "We give that food to our swine . . . doubtless we might propa-

THE DELL.

gate its use among our common people." The amiable diarist would no doubt be gratified to see how amply his prophetic hint has been acted upon by "the common people," especially the boys, that frequent the Park to-day. In the old time the beating of the trees was carried out as a necessary work, and at considerable cost; but we have changed all that—the beating is informal, done with sticks, stones, caps and other missiles, and entirely *con amore;* occasionally a keeper will catch one of the amateurs at work, and then the tree has its revenge!

With an interval or two, perceptible now in an unequal gradation of size, chestnut planting seems to have gone on fairly continuously, especially during later years; and naturally the better part of the fruit is borne by the young trees. The advantage of youth, however, goes no further. Independently of size, and the increased dignity which goes with it, the old chestnut is a much handsomer tree than the young; the main difference lies in the bark—perhaps the chief glory of the full grown or ancient tree. One can only wonder at the magic which converts the lifeless, lustreless casing of the young chestnut, pale yet dingy, neither smooth nor rough; and makes of it this marvel of ridge and spiral, and intricacy of network, and engraves upon every inch of its surface these quaint and lovely devices, so that the tree stands complete, like a great art work, perfect in form and colour, in majesty of stature and beauty of detail.

But alas for strength! Alas for beauty! Mere grass for the scythe of Father Time! All the trees of the first planting are more or less decayed; some of them mere wrecks; but still the spring brings fresh green to them as to the youngest; still they hold up their broken and blackened limbs to feel again the blessings of sunshine and air, and to invite the birds to shelter and nesting as of old.

A QUIET SPOT TO REST.

The elms of Greenwich Park, notwithstanding the advantages of royal planting and cultivation, are, on the whole, somewhat disappointing. Set much too closely together, the size even of the largest is only moderate; many of them lean considerably, a most unfortunate defect in an arcade. The capricious habit of the elm in the extension of its branches is here seen in excess, the branching of many of the trees being not only irregular but insufficient; whilst the hand of man, felt in the more or less necessary dismemberment of old trees, seems to have had a more than usually disfiguring effect.

As in the case of the chestnuts, perhaps the best elms are those out of the avenues, growing singly or in irregular groups, and the pasture lands (as distinguished from the pleasure grounds) of the Park form a simple rural setting proper for the tree; only the presence of browsing sheep and cattle is needed, or great cart horses freed from harness and labour, taking their ease in the grass.

Upon one of the grassy knolls, artificially steepened, and approached by a little winding grassy way, hollowed out probably by spade work of eighteen hundred years ago, are the scanty remains of a Roman villa. A few fragments of cut stone, tile-brick, rubble, and a little piece of tesselated pavement, are all that can be seen above ground. What may lie below, who can tell? But it is certain that here was once a human home, the scene of intense and varied human emotion; the pride of the patrician, the subjection and labour of the slave, with the familiar domestic affections common to both.

And the elm, that is ever found in human neighbourhood, that clusters about the homesteads and shadows the graves of so many an English village, the elm is here, surmounting the grassy hillock, befriending with its pleasant life this forlorn haunt of the dead. Decay has long been doing its work upon the tree itself, stamping it with the seal of mortality, and making it a still more pathetic memorial of vanished life and things forgotten.

A part of the Park, on the Blackheath side, is reserved of necessity for the use of the deer; and for such a purpose no one can begrudge the sacrifice. But a sacrifice it is, and a costly one; for the "Wilderness," as the enclosure is called, is a very delightful and characteristic bit of woodland scenery.

Oaks, bracken and fallow deer! Surely in these we have the very essence of Old England's—Merrie England's—greenwood scenery, and we cannot look upon them to-day without seeing all the sunshine of old romance quivering about them. Their glades are for ever peopled with

ONE OF THE GRACEFUL CURVES.

A GLIMPSE OF THE POND.

Pucks and Robin Goodfellows and all their elfish company; with Robin Hood and his merry men; with all the nut brown maids of all the ballads; and with Rosalind and Celia, Orlando, Jaques, and many another of Shakespeare's woodlanders.

The visitor privileged to enter the Wilderness may see the trees, the bracken, and the deer to-day, with as much else as his fancy may suggest. He will also see, in their season, flowers that seldom bless the Londoner's sight—wood anemones, wild hyacinths in the abundance which is necessary for their proper effect, mulleins both the great and the white, with patches of Lenten lilies, either growing wild or as strays from the gardens, the blue eyes of the speedwell, and wild strawberry blossoms among the moss.

The highest expression of natural delight can never be found in any park, public or private. One must go to the wild for it. The brook that dances and sings its way down the mountain side, the rowan that tosses its hair to the mountain breeze, the mosses that cover the stones, and the daisies which spring amongst them; these, with the primal freedom of wide skies and unploughed earth, are Nature's best, and have a greater power to charm than all the pride of the Dukeries.

We have not, however, the mountains here, but only Greenwich Hill; no wild, only a garden. Well, let us see how our garden grows, and what, if anything, can be gathered from it of the quality which we desire.

Well back on the hill plateau, the gardens and groves which surround the Ranger's House form the happiest hunting ground for such a quest. The old house, with its long, mellow-tinted front, facing the sunrise, has an air of peaceful homeliness, and gives proper character to the smooth lawns and chastely ordered flower beds. A little orchard lies at hand—crooked trees knee-deep in grass, with daffodils in early spring, and later white with cow parsley; beyond, the moving forms of deer beneath the trees.

A cedar grows upon the lawn, and, with perhaps equal beauty and distinction, Scots firs, lifting their ruddy stems into the sunshine. Great banks of rhododendrons thrive in the gravel soil; sycamores with mottled bark, oaks as yet unspoiled by London smoke, some noble thorns, with undergrowth of evergreens, form covers for secluded alleys—dark shadowed, yet streaked with beams of sunshine.

Pacing these walks, strolling about the lawns, or sitting in the grateful warmth of the early sun, the silence only broken by the incessant stream of bird song, that which is artificial in the scene begins to count for less, and the natural for more; the notice boards, iron railings, seats and other necessary afflictions sink to something like their true insignificance, and the pure joy of the morning, the glory of the sky and the unconquerable beauty of trees, begin to work their proper effect upon the mind; the shadows become substances and the real shadowy; and by the time the postman and milkman come bustling through the Park, one may have well-nigh forgotten the everyday prosaic state of existence, wherein the fetching and carrying of messages, and the supply of mere bodily wants, are, perhaps justly, considered necessary matters. Necessary, of course; but how well and happily sometimes forgotten. This is the true leisure—the mind occupied indeed, but occupied with matters that, in a worldly sense, do not concern us. "He that observeth the wind shall not sow, and he that regardeth the clouds shall not reap." Well, we need not always be sowing and reaping and gathering into barns: better sometimes to be idle and to dream; to be enamoured of the grace of tall elm tops stooping and rising to the wind; to be entertained by the glitter of the brightly coloured beetle amongst the grass blades; to let the idle sight follow the idle flitting of the butterfly; and the ear listen to the faintest, furthest going of the cuckoo's note, and to watch for and to gather the first and sweetest wild rose of the summer.

ARTHUR SCAMMELL.

A STUDY IN SEA "FIRS"

By S. F. MAURICE DAUNCEY

Illustrated with Photographs by the Author

IF during a holiday at the seaside you have chanced to walk along the beach after a heavy sea, you will have wondered at the strength of the waves. Here a bank of pebbles where the children were playing yesterday has been swept away; further on the rock against which you used to lie is no longer visible, and in its place is a mass of shingle and weed.

During your ramble the high-water line may have attracted your attention. At first sight what is gathered there has looked like a bank of rubbish, but upon closer observation it has disclosed hidden treasures. What an assortment of goods it has to show if you only take the trouble to turn over its tangled mass with your stick!

Blocks of wood covered with barnacles tell of the destruction of some old wooden groin. Here a crab, unable to regain the water, there a star-fish stranded in the confused weed, a few steps forward the shell of a sea-urchin —these objects tell of the force of the waves which has brought them so far up on the shore.

If you have stayed to examine some of the pieces of seaweed or bits of rock, you may have noticed a fine lace-like structure attached to them, or it may be washed free and lying on the beach. If, further, you have examined this structure with a pocket lens, what a surprise you have had.

It is composed of tiny cells and they form a horny skeleton. You will at once know that it is not, as you first thought, a bit of fine seaweed; for seaweed is never made up of cells like these. What is it, then? It is the skeleton of a colony of zooids, and its common name is "Sea Fir"—a name given to it because of the fir-like appearance of some of the coarser varieties. When alive, each little cell contained a jelly-like form called a zooid, which helped to feed the whole colony by

"SQUIRREL'S TAIL."

"SEA HAIR."

catching microscopic atoms of food with its fine tentacles. The colony grows and grows, until there may be many thousands of cells all forming but one framework.

These colonies may, as suggested above, be found adhering to many different objects—*e.g.* shells, seaweed, and rocks: but the shell of a Spider crab is the finest building site, for the constant movement of the crab takes the colony into fresh areas in which to "fish" for food.

Of the three illustrations, No. 1 (*Sertularia argentea*) is commonly called "Squirrel's Tail," and the illustration shows how justified is the name. This "fir" is of a much finer form than some others, the cells being much smaller. No. 2 (*Sertularia operculata*), commonly called "Sea Hair," is extremely delicate, and has no central rib as the two other kinds have.

No. 3 (*Sertularia abietina*) shows that variety which has appropriated to itself "Sea Fir" as its common name. It is one of those most commonly found on the beach, and also one in which the fir-like growth is very distinctly seen. It is quite a stiff structure, and of a light fawn colour.

The photos here reproduced were obtained by the specimen being placed on a piece of plain glass in a printing frame, and a sheet of photographic paper being placed over it. The frame was then exposed in full sunshine until the part of the paper where there was no "fir" became almost black. The prints were finished by first washing for five minutes in a solution of common salt (1 oz. of salt to 10 oz. of water), then rinsing in clear water and fixing in hypo bath (hypo 1 oz., water 7 oz.) for ten minutes.

"SEA FIR."

THE "LIZARD" ORCHIS

A fine specimen of one of Britain's rarest flowers

By the REV. H. PUREFOY FITZGERALD, F.L.S.

THE "Lizard" Orchis (*Orchis hircina*) is one of the rarest of our British flowers: as far as I am aware, it has been found in only four of the English counties, so that it cannot be called a wayside flower, and happy is the botanist that has the good fortune to light upon a growing specimen. I do not intend to give any hints as to where it may be looked for, because in these days, when so many of our rarer plants are rapidly becoming extinct, owing to cultivation, building, and the greediness of many collectors, it is just as well to keep some things secret, as far as it is possible to do so.

The photograph depicts well the general shape both of the flower spike and of the individual blossoms. The latter are rather large, the sepals and side petals meet, forming a sort of hood; these are of a pale greenish olive colour, with purple spots. The most remarkable point about the flower is the shape and length of the lip or labellum, as it is called, of one of the petals. This is divided into three segments, two short pointed ones, one on either side, and the middle one very long, generally over an inch. In the bud stage, this long lip is coiled spirally—on the flower opening the spiral uncoils to a large extent and becomes undulating; the end has the appearance of having been bitten off, leaving two or three small teeth. The colour of this long lip is greenish white, with a few purple spots at the base, and pale greenish olive towards the free end. The whole spike of loose flowers varies in length from four to eight inches, the plant being from one to two feet in height, it being one of the tallest of our native orchids. The flower emits a somewhat disagreeable scent, which is said to resemble the smell of goats very strongly. This is the explanation of the plant's specific name, *hircina* (*hircus*, a goat). The descriptive name of the "Lizard Orchis" was given to it from the somewhat fanciful likeness of this flower, with its long, greenish lip, to this reptile. It is of no use hunting for this plant except in a chalky district. Woods and meadows in such a locality may chance to produce a few specimens; about the end of June and during July is the flowering period.

Photograph by Douglas English.

THE "LIZARD" ORCHIS.

THE LIFE STORY OF THE PAINTED LADY BUTTERFLY

By JOHN J. WARD, F.E.S.
Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.
Illustrated from Original Photographs by the Author

RARELY can a butterfly be said to be cosmopolitan, but the Painted Lady almost achieves that distinction, for it is found (and often abundantly) in almost every country in the world excepting, perhaps, the Arctic regions and South America. Although the insect frequently occurs in large numbers, yet the irregularity of its appearance is striking. Sometimes, for several consecutive years, the butterfly collector diligently searches in vain for specimens; then some day unexpectedly, as he saunters along, he is overjoyed at the sight of one of these handsome insects on the wing. With net in hand he wildly pursues it, and the butterfly eventually alights in a meadow near by where thistle or clover blooms abound. Imagine, though, the astonishment of the collector when, after carefully approaching the spot, he finds resting on nearly every flower a Painted Lady Butterfly—a multitude of them before his eyes. Such an incident has happened to various entomologists in nearly every corner of the earth. Where the insects come from so suddenly after, perhaps, years of absence, has long been a puzzle. However, the fact that these insects migrate is now fairly well established; and this habit of migration, leading small or large groups to take advantage of suitable winds for the journey, probably accounts for the cosmopolitan distribution of the species, and at the same time for its numerical strength, for the race must naturally benefit by dispersal of its superfluous numbers to fields and pastures new.

A MAGNIFIED VIEW OF SOME OF THE BUTTERFLY'S EGGS.

Having now accounted for the sudden and extraordinary appearance of the butterfly, we may proceed to consider the details in the life history of an individual.

It was in the early morning of the 8th of June—the year need not concern us—when one of these butterflies suddenly put in an appearance on the English coast at Folkestone and selected its pitch of land—for an attachment to a

particular area, or stretch of land, about which they often career for several days together, is another curious characteristic of this species of butterfly. So our butterfly kept up the traditions of its race, and boldly manœuvred to and fro over its plot, occasionally resting and sunning itself on the tops of some tall thistles, where the charming chestnut browns and reds of its wings, contrasted with the black and white of the fore-parts, gave it a most fascinating appearance.

FROM THE EGGS CAME LITTLE CATERPILLARS THAT SOON MADE INROADS INTO THE SOFT PARTS OF THE LEAVES.

After it had worked off some of its superabundant energy, and had sampled the various kinds of nectar from most of the flowers that grew in its domains, this Painted Lady (for such she was in the strict sense of the word) proceeded to business. She made a kind of slow circular tour amongst a clump of thistles and nettles which were growing together, fluttering from plant to plant, and moving amongst their leaves as if carrying out a botanical investigation. A careful examination of a leaf on which the butterfly had been at work revealed some tiny pale green bodies dotted over the leaf—so small that four or five could comfortably rest on the head of a pin. Nevertheless they were wonderfully interesting little objects—the butterfly's eggs, indeed; and on page 778 some are shown as seen through the pocket lens of the writer.

Seeing that the butterfly herself feeds on the sweet nectar of the flowers, it is quite marvellous how she knows that her offspring will need green thistle and nettle leaves to feed upon; yet with unerring instinct she places her eggs amongst the leaves, and, apparently, she does not consider it important whether they are those of the thistles or the nettles.

WHEN THREE WEEKS OLD THEY SWARMED ABOUT THE NETTLES, AND ALL SEEMED DESIROUS OF FEEDING UPON THE SAME SPOT.

Five days later (June 13th) the butterfly had disappeared. Indeed, it was

highly probable that the spark of life within its frail structure had by that time succumbed to the large demands made upon it, for it is seldom that the insect lives for many hours after depositing its numerous eggs. However, the safety of her species was ensured. The tiny and prettily decorated eggs, which she had placed so carefully and systematically amongst the leaves, were now bursting open, and from each broken shell emerged a little caterpillar—a baby Painted Lady!

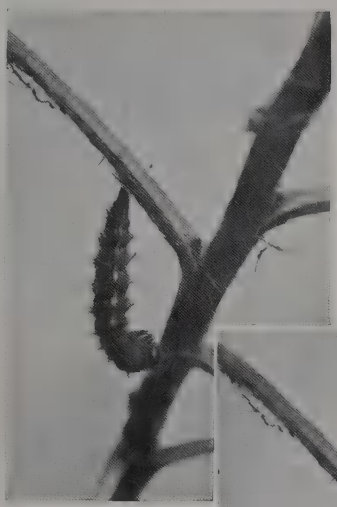
WHEN FOUR WEEKS OLD THEY WERE FULL GROWN.

These insect infants were greyish in colour, with rather large, shiny black heads, and covered with short bristles, and, of course, were very tiny when they first appeared. They soon proceeded to business, and made inroads into the soft parts of the leaves, and, at the end of a fortnight, their bodies darkened in colour, and they became conspicuous about the food plants (see p. 779). A week later still, they were exceedingly busy, and swarmed about the nettles; and the following week (July 10th) the caterpillars were full grown. They were then anything but handsome, their only decoration being some yellowish markings about their bodies; but not the slightest indication was visible that they were presently to become lovely butterflies.

Eventually, one of the larvæ stopped feeding, and, after carefully selecting a suitable site beneath a leaf-stalk, it slowly proceeded to spin a silken pad or cushion to it, finally attaching itself to this cushion by its tail claspers. In this way it suspended itself upside down, and there it hung a most dejected-looking object (p. 781). After it had been so hanging for a few hours, it commenced to squirm and wriggle its body, when its skin near the back of its head suddenly burst open. Then the caterpillar moulted its skin, for as the body wriggled the skin slowly shrunk up towards its tail-end, where it was attached to the silken cushion. The second illustration on page 781 shows this process taking place, just at the half-way stage. At the end of four minutes the shrunken skin was free, but it could not yet fall away, for it still had to be freed at the point of attachment to the stem. Presently, though, the developing insect detached itself, let the skin drop to the ground, and then re-attached itself to the silken pad (p. 781). This seems a very extraordinary feat, for, apparently, the insect must loosen its hold while allowing its cast skin to fall. However, close examination shows that at the extremity of the body are numerous minute hooks by means of which the insect attaches itself to the silken pad. It therefore probably detaches some of the hooks while the others remain connected, and so the skin is gradually passed over the point of attachment and falls to the ground. We no longer, then, have a caterpillar to consider, but a pupa, or chrysalis—the next stage of the insect's development.

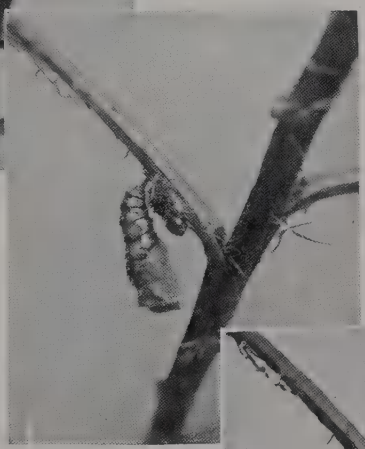
The chrysalis is at first of a greyish colour, but when it has been hanging for a few hours its angles become burnished, and it then presents metallic shades of various hues—green, crimson, gold, and silver, according to the position from which it is viewed.

On July 11th two larvæ became chrysalides at almost the same time beneath the cleaned central vein of a thistle leaf on which they had been feeding (p. 782), and there these pupæ hung motionless



THE FULL-GROWN LARVA SUSPENDED ITSELF BY ITS TAIL-END, AND PROCEEDED TO—

MOULT ITS SKIN. ABOVE IT IS SHOWN AT THE HALF-WAY STAGE.



AT THE END OF FOUR MINUTES THE SKIN WAS FREE AND THE CATERPILLAR HAD BECOME A CHRYSALIS.

FINALLY, IT LET ITS CATERPILLAR SKIN FALL TO THE GROUND.

for twelve days (July 23rd). But not until the end of that time did it become obvious that some further development was taking place. The chrysalides then lost their metallic splendour and became greasy, and through the outer skin the coloured wings of the butterflies, now almost ready to appear, became visible.

So few persons have seen a butterfly emerge from its chrysalis into its world of sunlight, that here was an opportunity not to be missed. To seize the opportunity, however, was not so simple as it seemed. Although we know from external happenings that the butterfly is almost ready to appear, yet just when it will emerge we are quite unable to foretell. Therefore, we have to wait Nature's time. This waiting sometimes becomes tiresome, for the butterfly may appear at any moment during about twenty-four hours from the time the chrysalis changes its colour; occasionally the butterfly emerges almost at once, while others may wait the whole of the twenty-four hours, or even longer; so that there is no criterion as to the exact time when the insect will appear. It is, therefore, essential that a careful and persistent watch should be kept upon the chrysalis, especially as the butterfly only occupies a few seconds in making its emergence and fully extending its wings.

After six hours of waiting, one of the chrysalides under observation suddenly moved—just a slight jerk. Then the broad end gently bulged and burst open. Through the opening immediately appeared the head of the butterfly, quickly followed by the fore-legs, by means of which the insect gripped the stem and so assisted in more comfortably extricating its latter parts (p. 783, No. 1). A moment later it was on the stem, leaving behind it the broken and empty chrysalis skin; and in this way the chrysalis changed to a butterfly.

How disappointing, though, is our butterfly! It has dumpy wings, looks like a cripple, and is altogether unlike the parent

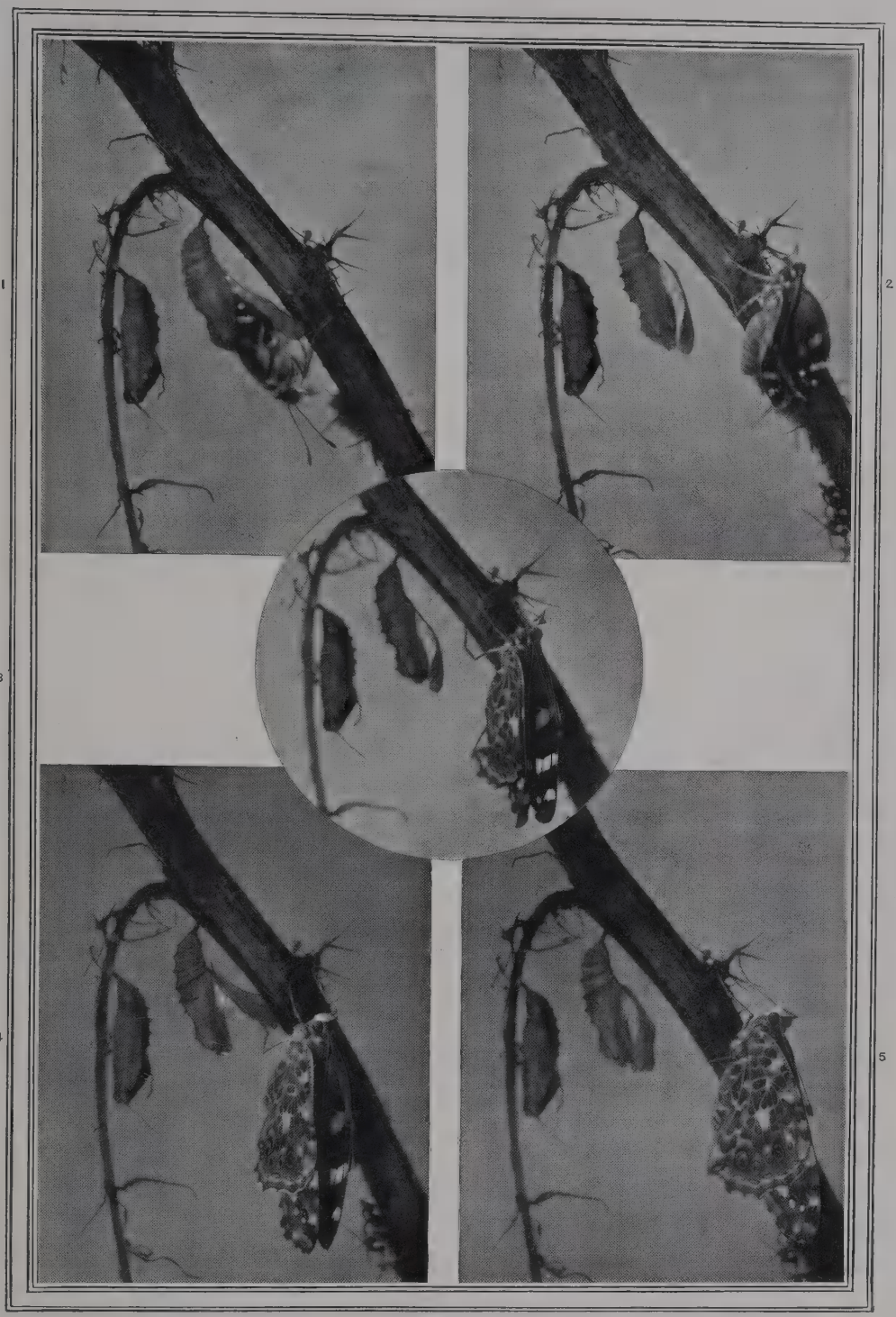
butterfly that so gaily flashed its colours in the sunlight. However, almost as soon as this thought occurs to us, our butterfly begins to grow in beauty before our eyes. Its dumpy wings lengthen out and begin to reveal their charming colours; indeed, the whole process is a delightful transformation scene in miniature. Yet there is no doubt about its reality; there the butterfly hangs on the stem of the plant—a lovely insect that a few moments before was apparently a dry and lifeless object.

TWO LARVÆ BECAME CHRYSALIDES AT ALMOST THE SAME TIME BENEATH THE CLEANED VEIN OF A THISTLE LEAF.

There, then, the butterfly hung clinging by its legs, its wings dangling in space, for they were limp and wet and quite unfit for flight. At the end of an hour, however, things had changed. It was then obvious that the wings were no longer wet and flimsy, for they had dried rigid and bore quite a trim and neat appearance (No. 5), and they were also under muscular control. This latter fact soon became apparent. It was nearly mid-day, and the bright sunshine was particularly attractive to this creature of the sunlight whose birth we had witnessed. Indeed, its frail form was so crammed with the joyousness of life that it could not afford to waste a moment of the golden time. Instantly the wings were under control the butterfly became impatient. Its feelers quivered, its legs moved rapidly to and fro, and finally its wings began to flutter; and at the same time the butterfly seemed to realise that it possessed a new and wonderful power. Restraint then was out of the question; away it travelled up the stem (p. 784) to the topmost point, and there it took its first outlook upon the new world of space it had to conquer. The erstwhile caterpillar that filled up every moment of its existence in searching for and devouring green leaves, allowing intervals for resting, was as dead and forgotten as if it had never been. Here was a creature whose food consisted of the sweet nectar of the flowers, and who would never eat a green leaf while it lived, for it lost its mandibles when it threw off its last caterpillar skin, and now it had only a long, coiled sucking proboscis which it unrolled, to search the depths of the flowers. Its outlook on life evidently gave it much satisfaction, for it suddenly opened wide its wings and revealed the lovely colours of their upper surface (p. 784). Where and how it got those marvellous organs with all their wondrous hues was all a mystery. Evidently green leaves were the working basis for their production, yet this knowledge does nothing towards explaining the mystery.

The opening of the wings was but a preliminary movement. After the butterfly had sunned itself for a few minutes, it quietly pushed off from the stem into space. It did not at first fly very far, but after a short rest it again rose on its wings, and then that same bold flight that characterised the parent butterfly when it careered over its selected plot near the sea-coast was reproduced almost exactly.

Yes, our butterfly, at least, was safely launched, but what would happen afterwards? Probably several days would be occupied in the simple pleasures of butterfly life, such as frolics in the sunlight with its brothers and sisters that appear about the same time, and imbibing all the sweet nectars from the various flowers. Or there may be love-making, for any day suitable winds may bring a few or a multitude of its species to its near neighbourhood, and amongst such visitors may, of course, come its mate. As we have seen,



THE BIRTH OF THE PAINTED LADY BUTTERFLY.

1. At the end of twelve days one of the chrysalides suddenly burst open, and the butterfly appeared.
2. A moment later it was on the stem.
3. The butterfly immediately began to grow in beauty—
4. As its wings fell from their folds.
5. At the end of an hour the wings had dried and were under muscular control.

THE BUTTERFLY BECAME IMPATIENT AND QUICKLY TRAVELLED UP THE STEM.

the development of the butterfly occupies only about six weeks, so that even in the short British summer there would be time for another generation to appear. Another possible happening is that some day when the brother and sister butterflies are sunning themselves, a strong wind may commence to blow, so strongly that with almost one consent the butterflies will rise and drift before it, and so be carried high and driven onwards and onwards, until at last the strongest fliers of the family that remain will find that the wind has ceased to blow, and that they have come nearer to the earth. So tired are they from their forced flight that they all alight. Of course, they may have dropped in some remote part of Europe or Africa, or elsewhere; but that does not matter in the slightest so long as nettles and thistles, or other food plants, are to be found there together with warm sunshine—those are all they need.

Perhaps, too, the same strong wind will have brought to the same place others of their species, among whom they will find mates that have also stood the test of a journey; and in this way, by the natural law of heredity, a race of still better fliers will be forthcoming for the journeys of the future. In this manner, from small beginnings, the species may have developed an instinct to fly before a strong wind; and as the species have benefited by the habit (because it extends the area over which the insect is dispersed, and thus enlarges its opportunities in life), so it naturally follows that the habit has become inherent, and thus we find that the Painted Lady can now claim almost the whole world as its home.

JOHN J. WARD.

IT OPENED WIDE ITS WINGS AND TOOK ITS FIRST OUTLOOK UPON THE NEW WORLD OF SPACE IT HAD TO CONQUER.

SPRING-TIME.

From the Water-Colour Drawing by P. J. Naftel in the Victoria and Albert Museum.

THE ELDER HEDGE.

HOW TO KNOW THE FLOWERS OF THE HEDGES

By the Rev. H. PUREFOY FITZGERALD, F.L.S.

Illustrated with Photographs by HENRY IRVING

THE Blackthorn, or Sloe (*Prunus spinosa*), is one of the first of the bushes to put forth its blossoms. As Gilbert White remarks, "This tree usually blossoms while cold north-east winds blow; so that the harsh, rugged weather obtaining at this season is called by the country people 'blackthorn winter'"; so that this flower is said to mark the division of the seasons—the end of winter and the live spring. The bark is of a blackish tint, and its common name is derived from this fact, so as to distinguish it from the Whitethorn, or May, which flowers later and whose branches have a much lighter tint. Towards the end of March, then, or, at any rate, quite early in April, the pure white blossoms of the Blackthorn should be found in the hedges, frequently before the leaves have begun to develop; the flower will be seen to resemble that of the Wild Rose.

The ends of the short branches are very pointed and thorny, and the plant must be handled with care. The leaves begin to develop generally before the flowers have withered, and the fruit is a small, globular, black plum, covered with a

beautiful purplish bloom when ripe ; this has a very inviting appearance, but a very sour and bitter taste, until a good frost has had an effect upon it, when its taste is not unpleasant. The Blackthorn has given rise, by long cultivation, to the Bullace, Damson, and the different varieties of Plum, to be found in our gardens, and on this account a deep debt of gratitude is owing to it. Many country people make a pleasantly flavoured wine from the fruit—winterpick wine, as it is called—and sloe gin is a well-known liqueur. Not very many years ago it was stated on good authority that much of the China tea of those days was made from the leaves of the Sloe.

THE HAWTHORN.

THE HAWTHORN

This plant is a near relation to the Blackthorn, both of them being of the Rose family. The Hawthorn (*Cratægus monogyna*) is also called May, or Whitethorn, the latter name referring to the lighter colour of the bark as compared with that of the Blackthorn. It is easily distinguished from the latter by its flowering season being later (it is seldom to be seen in bloom before the middle of May), the flowers being larger and fragrant, appearing after the foliage is well advanced. In the Blackthorn, also, the flowers are either single or in pairs, spreading along the branches; in the Hawthorn there are many blossoms on the same level, although their stalks start from different points, yet the whole appearance is more of a bunch. The foliage, again, is very different, for the leaves of the May are divided into segments which are irregularly toothed, while those of the Blackthorn are not divided, being of an oblong shape with the edges very finely but regularly toothed. In the autumn the flowers are succeeded by the well known red haws, which are a great source of food for the small birds during a hard winter. The word "haw" is a corruption of the old Anglo-Saxon for hedge.

THE BRAMBLE

Very few people will need an introduction to the Blackberry, or Bramble (*Rubus fruticosus*), as it is to be found in hedges and waste places everywhere. To the botanist, however, it is a most puzzling plant, as there are so many species and varieties which are very difficult to distinguish ; at the present time there are

THE BRAMBLE.

115 species that are known to grow in the British Isles, and that is not taking into account any of the varieties.

The Wild Raspberry, from which the garden varieties have originated, is a species of *Rubus* (*R. Idæus*) which is frequently met with; the Dewberry (*R. cæsius*) looks like a luxuriant variety of the ordinary Blackberry, but it is a distinct species, and may be distinguished by the fruit being covered with a beautiful bloom, giving it a very rich, inviting appearance and a blueness in colour which is wanting in the ordinary Bramble fruit. The Blackberry flowers do not appear to store any honey, but they are very much visited by insects for the sake of the quantity of pollen borne by the stamens, so that cross fertilisation very frequently takes place.

SPINDLE-TREE

The Spindle-tree (*Euonymus Europæus*) is a shrub which is more noticeable in the autumn than at any other time, on account of its brightly coloured fruit. This is the only British member of the Celastrus family; it is a smooth shrub, growing from some five or six to twenty feet high, with ovate, finely-toothed leaves. The flower stalks bear from three to five small, yellowish-green flowers, in May, which are not at all conspicuous; and in September the curiously shaped seed vessels ripen, remaining till long after the foliage has dropped off. These seed vessels, or capsules, are of a bright, rosy-pink colour, and are generally of a quadrangular shape, each of the four lobes containing a seed covered with an orange-red covering. Dyes of three distinct

THE SPINDLE-TREE.

colours—red, yellow, and green—are made from the fruit and seed. When fully ripe these capsules open, and the four lobes separate, exposing the orange-skinned seeds. In this state it looks very much like a flower, with pink petals and orange stamens and pistil.

The wood of the tree is very hard, and

PRIVET FLOWERS.

is useful for many purposes. Spindles or skewers are made with it, and this gives rise to the French name for it, *Fusain*. The local names, Prick-wood, or Prick-timber, has also the same reference. A special sort of charcoal for artists is made from the wood, as the lines which it makes are easily effaced. The other French name for it is *Bonnet du Prêtre* (the Priest's hat); this is given to it on account of the shape of the seed capsules.

The name of the Dogwood (*Cornus sanguinea*) does not refer to the animal, but to the fact that skewers are made from the wood; the prefix "dog" is a corruption of the old English *dagge*, meaning a dagger. Other local names for it are Prick-wood and Skewer-wood. This is a very common shrub in hedges and woods, and may be distinguished readily by the dark red colour of the young branches, and in the autumn by the beautiful crimson colour of the leaves just before they are ready to fall. The shrub grows to a height of five or six feet, sending out a good many branches; the bark is grey, and the young shoots red. The flowers are small, greenish white in colour, and with a somewhat disagreeable scent; there are several flowers in a cluster.

A good deal of honey is secreted at the base of the pistil, and the flowers are visited by all kinds of insects, especially flies. In the autumn the blossoms are succeeded by clusters of very dark purple — almost black — berries. These are very bitter to the taste; they contain a quantity of oil, which is sometimes used for burning in lamps and also in soap manufacture. The leaves give a wonderful gradation of colour, from green to dark crimson, and in this respect resemble the Euonymus; several very ornamental Cornel trees have been introduced of late years into England from North America. The name Cornus comes from the Latin *cornu*, a horn, and was given to the shrub because of the horn-like nature of the wood.

THE ELDER

A small, much branched tree very often to be seen growing in hedges and thickets, is the Black Elder (*Sambucus nigra*). It belongs to the Honeysuckle family (*Caprifoliaceæ*), although it seems at first sight to have very little in common with the other members of the family. The leaves are pinnate, cut into five or seven segments, sharply toothed, and quite smooth. The cream-coloured flowers are borne in a big flat cluster, about six inches across,

THE BLACKTHORN.

DOGWOOD.

each little blossom possessing a five-cleft calyx, a five-cleft corolla, five stamens, and three stigmas; this is succeeded by a round, one-celled black berry, very much the same size as a buckshot. The bark of the old wood is greyish yellow, whilst that of the young shoots is green. Both the stems and the branches are full of a light, spongy pith, which can be easily removed, leaving the hollow stem, well known to boys for making whistles and popguns.

As to the origin of the name Elder, Prior states that the word is derived from the Anglo-Saxon *ældd*, meaning to kindle, "A name which, we may suppose that it acquired from its hollow branches being used, like the bamboo in the tropics, to blow up a fire." In old times the tree was supposed to have great medicinal properties, and a perfumed liquid, called Elderflower water, was made by distilling the flowers with water and alcohol.

In many country districts Elderflower wine, and also Elderberry Wine, still are made in considerable quantities. It is said, too, that the juice obtained by pressing the berries was, at one time, largely used in adulterating foreign wines. No honey is secreted by these flowers, but there is a very sweet scent which serves to attract insects.

PRIVET

The Primprint, or Privet (*Ligustrum vulgare*), is a common shrub, the more so because it is largely used for making hedges. It, like the common Ash, is a member of the Olive family (*Oleaceæ*). The leaves are opposite, and all of them smooth and undivided, and nearly evergreen. The white flowers are borne in short panicles or bunches at the ends of the branches, and have a faint, sweet smell; these are succeeded in the autumn by purple-black berries, which remain on the shrub for the greater part of the winter or until they are demolished by the birds. The name Privet is a corruption of *Prymet*, which in its turn is derived from the French *Prime Printemps*, a name formerly given to the Primrose. Dr. Prior states that the generic name, *Ligustrum*, was at one time applied to the Primrose, but that it was afterwards transferred to this shrub—hence the confusion in the names.

H. Purefoy FitzGerald.

THE VOICE OF NATURE

Some reflections on the young life of early summer

By BENJAMIN HANLEY

Illustrated with photographs by the Author

So far as young bird life is concerned June is the richest month of the year. In the hedges flocks of young starlings multiply, chattering and screaming, day by day; families of warblers, newly fledged, creep through the tangled thickets; young tits go piping through the woods in single file; and the early plovers gather into flocks. But the nesting season does not end with June, for many partridges have, as yet, scarcely finished laying their clutch of olive-tinted eggs; the yellow-hammer, whose jingling trill is heard all day by the wayside, and the corn bunting, who imitates his cousin's song, but is never able to give it the finishing note, have, as yet, hardly thought about nest building. By the breeding grounds of the lapwings, too, should any robber gulls put in an appearance, the wild yet musical "willow-weet-pee-wit" of the protesting plovers tells one that there are still eggs and brooding females to be protected; and to judge by their calling, the land-rails have barely got used to each other's company, and the nest is not yet made. So that even in June, rich as it is in young bird life, one may find numerous eggs.

Playing around the mouths of their

retreats young rabbits by the score may be observed. They have many endearing ways, and one's heart instinctively softens toward them when, from some point of vantage on a sunny afternoon, they are seen daintily performing their elaborate toilet, often assuming attitudes and poses so comical and grotesque that one is obliged to laugh, and then an array of white tails bobbing for shelter as fast as legs can carry them is seen. After a few moments one pair of sharp little eyes after another will peep out until they are all once more enjoying the sunshine, and on the watcher continuing his way, scamper off again to their underground homes.

A YOUNG SPARROW-HAWK.

As summer advances, the air grows thick with insects of all descriptions, varying in size from the largest dragon-flies to tiny microscopic creatures beyond the ken of our naked eyesight.

Butterflies flutter aimlessly from flower to flower; dragon-flies dart swiftly to and fro on gauzy wings, glistening and shimmering in the sunlight; humble bees buzz lazily by, overtaken by the more energetic hive bees and wasps; bluebottle flies bask in the sun, and ichneumon flies flit quickly past on the lookout for the larvæ of other insects, in order to deposit their eggs in the unlucky grubs, or near them.

What a freshness there is after a sudden shower, when the land is all but baked by the heat of the sun's rays! The old-fashioned sweet-briar especially fills the air with its fragrant perfume. The birds, too, seem as if they cannot refrain from singing, and almost every member of the bird world voices its thanks for the refreshing shower—voices widely different, yet blending together in one perfect whole. From all sides the avian music ascends, and there is no difficulty in picking out the lark's carolling, the thrush's whistling, the blackbird's piping, the cuckoo's calling, or the sedge-warbler's inimitable chattering, from the sweet chorus.

June is rightly named the month of flowers, for never is such a wealth of bloom to be found any other month—turn which way you will flowers innumerable greet the eye. The hazel-leaved blackberry, which blooms later than the dewberry and earlier than the common bramble, is now in flower, and often, too, from the tangled bramble bushes the woody nightshade thrusts forth its climbing stalks, hung at intervals with clusters of purple flowers, each with a yellow centre. In the lanes the wild rose is in full bloom and makes a star-spangled banner of the hedgerows, whilst the honeysuckle—sweetest and best beloved of all—is beginning to open, and will soon tempt the nectar-loving insects to gluttony. Along the banks and in the meadows the most common flower of all is the dainty bird's-foot trefoil—"lady's fingers" the children call them—and near by one is almost sure to find the trembling or quaking grass, which verily seem, like the leaves of the

aspen, as if they were never still. The pink and white campions grow on all sides, and in the bottom of the hedges the white blooms of the greater and the tiny, starry flowers of the lesser stitchwort may be seen. Along unfrequented pathways by the streams the large spreading leaves of the butter-bur, which masters of the brush love to include in the foreground of their pictures, seem to smother everything but the pinkish-white flower discs of the cow-parsnip topping its three feet of stalk; but lovely above all others is the meadow cranesbill, with its large purple-blue flowers of almost unpaintable hue. The elder bushes are decked with flat discs of creamy white flowers, and from a distance the guelder rose bushes appear similarly garbed; but in the case of the latter, large and small flowers are borne on the same stalk—the larger flowers being barren and placed round merely as an attraction for insects.

Words fail to picture the delights of a June evening when the sun, after shining for sixteen long hours from a cloudless sky, is slowly sinking beneath the western horizon—a great red ball of fire. The whole countryside presents a scene so peaceful that it baffles description.

The cuckoo calls from an oak tree near by, and soon evokes an answering note from a couple of fields away; the musical "tur-tur" of the turtle-dove comes from the distance, and from the other side the more pronounced cooing of the wood pigeon; from amongst the rushes and sedges by the water-side the moorhen croaks, and the water vole rustles his way through the dry reed stems. Twenty or thirty yards away the head and ears of a hare appear as she sits on her haunches to peep above the growing corn; hedge snails are feeding upon the vegetation, and through the grass many black slugs make their way. An occasional beetle flies past with murmurous droning; various moths come from their daylight resting-places, and the little pipistrelle bat issues forth to flicker to and fro with seemingly uncertain flight. The shrew squeaks shrilly in the grass, and enow the king of the night folk—the barn owl—sails around on silent wings, presently giving vent to such a weird, uncanny scream as must surely blanch with terror the hearts of all rodents starting on their nightly prowls, and send them scuttling off home again in no uncertain manner. From a wood over the way comes the loud cry of a startled pheasant, and as if to follow his example, a blackbird flies hurriedly out of the bush where he obviously intended roosting, with noisy cackle, and the sedge warbler, which had settled down for a time, breaks out anew to chatter and scold for all he is worth.

BENJAMIN HANLEY.

A YOUNG CUCKOO.

HOW TO KNOW THE WILD ANIMALS

By DOUGLAS ENGLISH, B.A., F.R.P.S.
Author of "Wee Tim'rous Beasties," "Beasties Courageous," etc.

THE BATS

With Photographs by the Author

IT was not without reason that mediæval artists, when faced with the necessity of raising devils from their inner consciousness, should have invested them not only with the wings, but also with the countenances of Bats.

So far as facial beauty was concerned it might have proved difficult to appraise the claims to distinction of the various Orders of animals; to differentiate, for example, from an æsthetic standpoint, between a Squirrel, a Hedgehog, and a Stoat. In the case of facial ugliness there seems to have been no such difficulty. Mediæval artists accepted Bats as the *ne plus ultra*, and their view was adopted by artists of the Renaissance. In Dürer's "Knight, Death, and Satan," the countenance of the Fiend, though of a somewhat composite character, appears to be modelled on that of a Bat of the genus Megaderma; while another familiar mediæval devil, who possesses a pair of projecting tubular nostrils over a grinning, thin-lipped mouth, reminds one strongly of the genus Harpyia. Both these genera of Bats may well have come within the experience of mediæval travellers, and it is not unlikely that the reminiscences of the latter may have pointed morals or adorned tales, in which the primal contrasts between "light" and "darkness," and between "good" and "evil," were regarded as synonymous.

As Ingersoll puts it: "While the graceful pinions of birds have been given to angels of light, the leathery and angular wings of the Bat have been used by painters and sculptors to signalise the forms of fiends."

It must not be supposed, however, that *all* Bats are hideous. Several of the large fruit-eating Bats, those known as "Flying Foxes," for example, have agreeable vulpine faces, while the majority of our twelve British species may be described as being, for Bats, passably good-looking.

The extreme of Bat ugliness is reached in what are known as the Leaf-nosed Bats (*Rhinolophidæ* and *Phyllostomatidæ*), and is due in the main to an extraordinary fleshy outgrowth surmounting and surrounding their nostrils. This outgrowth, though symmetrical about the centre line of the face, presents remarkable specific variations of pattern. In conjunction with diminutive eyes, impish ears, glandular protuberances on the cheeks and muzzle, and a gaping bare-toothed grin, it ensures an expression of countenance for which "demoniacal" is the only fitting term. The *Phyllostomatidæ* (Vampires) are not represented in this country, but we have two representatives of the *Rhinolophidæ*, who, from the formation of their nose-leaves, are known respectively as the Greater and Lesser Horseshoe Bats.

The function of the nose-leaf, of which traces are to be found in certain Insectivora, as well as in Bats belonging to families other than the two just mentioned, is unknown. The old theory that it was in some fashion a sense organ has been materially weakened by recent investigations into its structure, while its superior development in male Bats suggests that it may be nothing more than a sexual adornment. Against this must be put the fact that the "leaf-nosed" Bats are the most highly organised of the insect-eating, as opposed to the fruit-eating members of the Order. They are

distinguished by a peculiar neatness of flight—Mr. Coward describes the Lesser Horseshoe Bat as turning in the air

THE SEROTINE.
Noticeable points are the pad at the base of the thumb—which is possibly the remnant of a sucker—and the triangular naked patch in the centre of the under lip.

immediately before alighting, and so avoiding the laborious reversal which is necessary in the case of Bats which alight head upwards—and one would naturally expect to find in Bats so distinguished some clue to the nature of that delicate sense-perception which is characteristic of Bats in general, and whose existence, first investigated by the Abbé Spallanzani, has been confirmed recently in this country by Mr. A. Whitaker. In Spallanzani's experiments specimens of the Noctule, the Long-Eared, and the Greater Horseshoe Bats were completely blinded, and deprived, as far as was possible without killing them, of the senses of smell and hearing. They were then "set at liberty."

"It was discovered that under these conditions they could conduct their flight through subterranean passages without striking against the walls, that they turned exactly as the most complicated windings required, and that they even avoided, with great exactness, cords, branches of trees, and other obstacles."

Mr. Whitaker's experiment is described by Millais as follows: "He obtained a Natterer's Bat and covered its closed eyes with wax, fastening it with a little patch of rubber and solution, and then released the Bat in a room in which it had not been before. When, on previous occasions, other Bats had been at liberty in this room they had usually circled round close to the ceiling; but this blinded Bat at first flew in a hesitating manner, and then, gaining confidence, went straight towards the closed door. It stopped when about six inches away, and hovered slowly along the line of the top and right down the side, without doubt keeping its position through its sensitiveness to the slight draught which came through the tiny chink. Finding no opening large enough to get through, it flew quickly down the room towards the fireplace, no doubt again feeling the draught, but turned away when it felt the heat of the fire. It flitted then close to the wainscot, hesitating repeatedly at a spot where the woodwork was a little sprung and there was again a sensible draught. It flew quickly, passing under chairs, of which there were twelve in the room, besides other furniture, and never even touched anything with the tips of its wings. An attempt to catch it showed that, although incapable of sight, it was well able to dodge; but it constantly

THE PIPISTRELLE.
The small common Bat.

stopped in its flight, hovered, and scratched at the covering over its eyes. When a stick was held in its direct path it avoided it when three or four inches away. When it wanted to rest it settled on one of the

weights of a gas chandelier in quite an orthodox manner, and when a hand was stretched out to capture it, it flew off again before it was touched. . . . The animal's sight was in no way injured when the wax was removed."

It would appear that the object both of the Abbé Spallanzani and of Mr. Whitaker was to prove that the absence of actinic light has little, if any, effect on the ability of a Bat to avoid obstructions in its line of flight.

This fact can be more simply and more humanely determined by confining oneself in company with a lively Bat in a small darkened room, and creating such obstacles as may seem desirable by a suitable disposition of oneself and of the furniture. If the darkness is complete, and the silence is complete also, it will be found that one's own sense perceptions (other than that of sight) are so sharpened as to enable one to determine certainly, after a little practice, whether the Bat is flying, resting, or scrambling about. As a ready means of confirming or refuting one's first impressions an electric pocket lamp is useful. One "feels" the approach of the Bat to one's face, and one "feels" it sheering off. One "hears" the interruptions to its flight. More than once, under such conditions, I have known the Bat to settle on my clothing, on my outstretched hand, and even on my head, but this has never been with the force of a collision, and it seems reasonable to conclude either that a Bat's eyes are sensitive to rays which are invisible to human beings, or that the Bat possesses some sense-perception which is independent of vision, and is infinitely more delicate than the similar sense-perception which we ourselves may experience under suitable conditions. It seems likely that this sense-perception may be governed by delicate atmospheric impressions—temperature, resistance and elasticity of the air, draught, moisture, and so forth—and that it may be in some way connected with the innumerable "sense-hairs," which are to be found about a Bat's muzzle, on his ears, and scattered over the relatively enormous surface provided by his wings. It should be remembered in this connection that each "sense-hair" contains a nerve-fibre.

The wing-structure of Bats is unique. In several of the so-called "flying" animals (Flying Phalangers and Flying Squirrels, for example) an expansion of hairy flank-skin connects and includes the main portions of the limbs on either side of the trunk, but leaves the hands and feet free. The horizontal extension of the limbs stretches this integument into a four-sided sail, and, trusting to its strength as a parachute, the "flying" Squirrel, or Phalanger, is capable of executing prodigious leaps and long aerial glides. The "Flying Lemur," or Colugo, is still further specialised. His feet, hands, and tail are included in a similar parachute membrane, leaving only his muzzle and claws free. Wallace has described him as gliding obliquely downwards through the air for a distance of seventy or eighty yards, and as being capable of steering a definite course. In none of these "flying" animals, however, are the limbs markedly abnormal in structure, and the height to which they can *rise* in the air is limited to their leaping power.

THE NOCTULE.
Earlet (Tragus) can be seen plainly.

In the Bats, on the contrary, we find a genuine power of flight, and a corresponding modification of structure. The

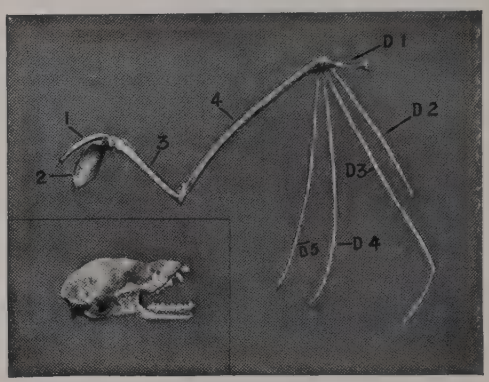
upper arm bone (*humerus*) of a Bat is abnormal, the chief fore-arm bone (*radius*) more abnormal, and the finger bones most abnormal of all. The peculiarities of these bones may perhaps be best realised by comparing their proportions with the proportions of the corresponding bones in ourselves. Though the latter may exhibit considerable variation in different individuals, it may be said that in the average human male the distances between the breast-bone and the shoulder-joint, the shoulder-joint and the elbow, the elbow and the wrist, and the wrist and the middle finger-tip, are roughly in the proportion 3 : 6 : 5 : 3. In the Long-Eared Bat the corresponding proportions may be taken as 1.4 : 3 : 5 : 8.

If we were in imagination to set ourselves the task of converting a human fore-limb (seven inches, say, from breast-bone to shoulder, fourteen from shoulder to elbow, eleven from elbow to wrist, and seven from wrist to middle finger-tip) into a fore-limb of similar proportions and structure to that of a Long-Eared Bat ; if, that is, we were to endeavour so to modify a human skeleton that its owner might have reasonable prospects of being able to fly, we should find that, to begin with, the following extensions would be necessary. Leaving the collar-bone at seven inches, the upper arm bone would have to be lengthened to fifteen inches, the fore-arm to twenty-five inches, and the middle finger-bones to forty inches. The limb, that is, outside the trunk, would have to be extended to two and a half times its previous length. The thumb might be left at seven inches in length, starting from the wrist, but would have to be armed with a prodigious claw. The fingers, varying from twenty inches to forty inches in length, would have to be connected with each other, with the inner surface of the arm bones, with the side of the body, and with the outer surface of the leg bones (as far down as the ankle), by an elastic folding membrane richly supplied with nerves, muscles, and blood-vessels. When the arm was extended outwards and the fingers opened fan-wise this membrane would cover an area of about thirty square feet, and an additional spread of sail would be secured by a triangular membrane whose apex was at the elbow-joint and base a line connecting wrist and shoulder, and also by a membrane connecting the inner surface of the leg bones as far as the ankle with a prolongation of the vertebræ in the form of a tail. The total wing area on both sides of the body might be as much as eighty square feet, but even this would hardly support more than a tenth of the original weight. The latter would have to be enormously lessened, by a re-arrangement and lightening of bone and muscle, before our human Bat could fly. He would have to develop a hump-back and a pigeon-chest. His neck vertebræ would have to describe a S-shaped curve so that the back of his head might nestle between his shoulder-blades. Several of his skull bones would have to be reduced to cartilage. His breast-bone and ribs would have to coalesce for the support of his pectoral muscles. His pelvis and lower limbs would have to be greatly reduced, and his thigh-bones would have to be rotated at the hip-joints in such fashion that his knees were directed backward—a position, it may be noted, which is aspired to by those who would skate the "spread-eagle." Finally, the folds of his ear would have to be ironed out and pulled upwards so as to form a conch nearly a yard in height, and his tragus (the small projecting lobe which is directed from front to back across the ear-opening) would have to be lengthened in the same direction for about a foot.

The necessities of an aerial existence of which the wakeful portion (often limited to an hour or so per diem during favourable conditions of weather) is spent in the incessant pursuit of flying insects have naturally influenced the domestic economy of Bats. They pair normally in late summer or autumn. Shortly after this hibernation may ensue, and the young may not be born until May or June of the year following. Hibernation naturally overtakes their growth, and they are not mature for a twelvemonth. It is rare for more than a single infant to be produced at a birth, for the excellent reason that the mother carries her infant about with her in flight, and tends it unceasingly until, when perhaps a month old, it is fit to catch flies for itself. It clings to her

A PAIR OF NOCTULES.

fur partly by the thumb and foot claws, and partly by the milk teeth, whose recurved and often bifurcated points are singularly well adapted for the purpose. The infant Bat is blind and practically naked, while immature Bats of the year are usually markedly different in colour from Bats of the previous generation. It is probable that from, say, May to August the females congregate apart from the males so as to have the control of their family affairs undisturbed, but, during hibernation, Bats of both sexes, and often of several different species, may be found by the score in suitable retreats—caves, ruins, hollow trees, and so forth.



FORE-LIMB (× ⅔) AND SKULL (NATURAL SIZE) OF LONG-EARED BAT.

1. Collar bone (clavicle).
2. Shoulder blade (scapula).
3. Upper arm bone (humerus).
4. Fore-arm bone (radius); the ulna is merely a splint.
D 1. Thumb (pollex). D 2, 3, 4, 5. Fingers.

The thinness of the bones composing the skull can be judged from the fact that the roots of the teeth in the upper jaw can be seen through them.

The duration and profundity of their winter sleep is dependent on the temperature of their immediate surroundings, and if, as seems likely, the crowding of Bats during hibernation maintains this temperature at such a height as to prevent complete torpidity, their jostlings, changes of position, and, as Millais happily puts it, "seething," may be easily accounted for. The Noctule, Serotine, Pipistrelle and Long Eared Bat may be considered "light" sleepers. The fact that a hibernating Bat, or a Bat that has been reduced to a comatose state by the vagaries of our English summer, feels damp as well as cold may, perhaps, be due to the numerous secreting glands on a Bat's body. To such must certainly be attributed the singularly noisome odour which several of our Bats, notably the Noctule and the Serotine, diffuse at random.

All British Bats are insectivorous, and not only the character of their flight—which, be it noted, is a most difficult and uncertain criterion for distinguishing the species—but also the heights to which they ascend, and the localities which they affect, are determined by the flight and distribution of the insects on which they are feeding. I have watched Noctules hawking a hundred feet up where it was impossible to determine with a glass what they were after, and I have seen more than twenty of them together not more than twenty feet from the ground, engaged in annihilating a brood of the smaller stag-beetle (*D. parallelopipedus*) whose first experience of a free-flying existence was terminated almost before they had quitted the decayed walnut trunk which for some years had provided them with food and shelter.

Although I watched this episode with keen attention, I was unable to detect a single instance of a Bat "pouching" its victim. More than one observer has described a manœuvre by which captive Bats make use of their interfemoral (tail) membrane in order to secure a hold of a refractory moth or beetle, and one would have thought that a beetle of the size of *D. parallelopipedus* would have necessitated some such expedient.

As it was, however, the Bats seemed perfectly satisfied with two or three sharp and audible crunches, after which they allowed what was left over to drop from their mouths. The ground beneath them was strewn with legs, wing-cases, and insect remnants generally. Occasionally a whole beetle would come down, and two or three of those which I picked had been practically bitten in half. It is, of course, possible that an *embarras des richesses* had in this case disturbed the normal order, but I am inclined to think

that "pouching" is only possible in the case of "arboreal" Bats who can steady themselves by clinging to bark or foliage during the operation.

I am equally doubtful as to the possi-

A PAIR OF NOCTULES.

The one on the right is in the normal head-downwards sleeping position. The one on the left is commencing to bestir himself, the first step being a slow movement of the head from side to side, and a groping for foothold with the thumbs, preliminary to launching into the air.

bility of a Bat using the interfemoral membrane as a rudder. A Bat's hind-legs are kept stiff in flight, the movement of the wings being from the shoulder-joints, and in most British species the tail is recurved towards the belly. It is conceivable that the pouch so formed may serve as a brake when the Bat dives; and that a moth or beetle missed by the Bat's teeth may on occasion get caught up in it. I am inclined, however, to doubt the likelihood of a Bat flying for any distance with his nose jammed against his tail, as would necessarily be the case if the tail membrane were used as a feeding trough.

In any movement but flight Bats appear to singular disadvantage. Their progress is impeded by the spread-eagling of their legs, by the disproportionate length of their arms, and by the continuity of the membrane between their legs, arms, tail and trunk. In scrambling they advance in order: (1) the fore-limb until the thumb-claw is engaged, (2) the hind-limb on the same side of the body, (3) the opposite hind-limb, (4) the opposite fore-limb, and so *da capo*. The pace to which they attain by this awkward lopsided shuffle is remarkable, while the ease with which many Bats can soar from the flat is astounding. If by any mischance a Bat finds himself in water, he "rows" himself clear with his wings.

One would have supposed that Bats would often be taken by owls. This, however, seems to be an infrequent accident, and it is possible that owls have learnt by experience that the nutriment contained in a Bat is disappointingly small. I have often picked up moribund Bats who showed clear signs in the shape of broken wing-bones, slit ears, and so forth, of having received rough treatment. One can seldom do much for them. I endeavoured on one occasion to set the broken radius of a Serotine, putting it in miniature splints and securing these by silk passed through the wing membrane. Although at the commencement of the treatment the animal appeared to be in excellent condition, he refused food and died five days after I had picked him up. I was unable to satisfy myself that the broken bones had in any way tended to unite. During the actual setting of the fractured bone the poor brute's screams were piteous in tone and of an entirely different quality from that needle voice of Bats which is strident to the hearing of some human beings and imperceptible

THE LONG-EARED BAT.

The wonderful ears are semi-transparent, and when viewed against the light form a beautiful object, often of a delicate pink colour.

to that of others. A Bat's normal squeak can be perfectly imitated by striking the edge of a sixpence against a penny.

The subjoined list is based mainly on the writings of Johnston, Millais, and H. E. Forrest.

GREATER HORSESHOE BAT.—Nose-leaf. Pointed ears. Straight tail. Length (nose-tip to tail-tip) about 4 in. Wing stretch 10½ in. Adult red- or grey-brown above, grey below. Immature, grey. Females sometimes golden brown. South and especially S.W. England.

LESSER HORSESHOE BAT.—Nose-leaf. Pointed ears. Straight tail. Length about 3 in. Wing stretch 8½ in. Grey-brown above, grey below. Immature, grey. Distribution similar to above, but has been recorded from N. England and Ireland. At rest both the Horseshoes shroud themselves completely in their wings, and resemble chrysalides.

BARBASTELLE.—Ears high and broad, indented on outer, almost touching at inner margins. Rudimentary nose-leaf. Eye included within the base of the ear. Earlet (tragus) triangular, with semicircular notch on outer border. Length 4 in. Wing stretch 10 in. Blackish or deep red-brown. Hairs light at tips. Sparse white hairs on tail membrane. S. England. Uncommon.

LONG-EARED BAT.—Ears enormous, often folded back at rest, leaving tragus projecting and conspicuous. Rudimentary nose-leaf. Length 3½ in. Wing stretch 10 in. Common everywhere. Arboreal. Often out in day-time.

SEROTINE.—Wing membrane rising from half way up the soles of the feet. Tail projecting naked for ¼ in. Size large. Length 4¾ in. Wing stretch 12–13 in. Ears almost as long as head. Tragus narrow at base, then widening, then tapering. Dark brown above, dusky below. Greasy fur. Smelly. Slow, laboured flight on occasion. Often out in day-time. S. and especially S.E. England.

THE SEROTINE.

The extension of the wing membrane beyond the ankle and up to the base of the toes can be seen in this picture.

NOCTULE.—Wing membranes rising from ankles. Size large. Length 5 in. Wing stretch 13–15 in., but fingers comparatively short. Ears short. Tragus short and squarish. Rich warm-brown body fur. Smelly. Common in S., rare in N. Unknown in Scotland or Ireland.

LEISLER'S BAT.—Smaller than, but like preceding, and perhaps should be regarded as a local variety. It is said that the lower incisors are more crowded than in the Noctule, and that the hair is lighter at the tips. Takes the place of the Noctule in Ireland.

PIPISTRELLE.—The *common* Bat. Small. Length 3 in. Wing stretch 8½ in. Face covered with short fur. Great variation of colour from russet to pale brown. Thirty-six teeth.

WHISKERED BAT.—Very small. Length 2⅞ in. Wing stretch 8½ in. Upper incisors diverge laterally. Ears with strong indentation in middle of outer border. Tragus long and straight-edged. Face covered with long hair. Generally distributed. Thirty-eight teeth.

DAUBENTON'S BAT.—Very large feet. Length 3¾ in. Wing stretch 9 in. Light-coloured breast. Fond of skimming across water. Generally distributed.

NATTERER'S BAT.—Interfemoral membrane bracket-shaped and its margins bordered with short stiff hairs. Light-coloured breast. Length 3⅜ in. Wing stretch 11 in. Tragus very long, straight, and sharp. Generally distributed.

BECHSTEIN'S BAT.—Ears large and of a characteristic shape, bending outwards at an angle of 78° and turning upwards to the perpendicular (Millais). Length 3½ in. Wing stretch 11 in. Short tail.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—I

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE WILD GUELDER ROSE AND THE WAYFARING TREE

NO very hard and fast division can be made between the Trees and the Shrubs. Some trees, under certain conditions, or as the result of accident, may assume the shrubby habit ; and some shrubs may, from some predetermining cause, become small standard trees.

The shrubs are those which, by putting up several stems simultaneously, of about equal strength, evince a decided tendency to grow bushy. Generally, also, the lowermost buds on these stems grow out earliest and more strongly, so confirming this habit of growth.

THE WILD GUELDER ROSE

This shrub is classed with the Honeysuckles in company with the Wayfaring Tree, the Elder, and the Snowberry. The chief point they have in common is with respect to the flower, whose five petals are united, forming a tube to which the stamens are attached. This falls away in a single piece. The fruit grows beneath the calyx as in the Apple group. The buds and leaves are in opposite pairs.

THE WILD GUELDER ROSE.

FRUITS OF WILD GUELDER ROSE.

The Guelder Rose, or Snowball Tree, of our gardens is but a variety, if it were not better described as a monstrosity, of the wild shrub; yet by a curious perversion it has given to this shrub its popular name, Guelder (or Dutch Gelderland) Rose.

The Wild Guelder Rose is found chiefly in moist places. It loves the steep banks of small streams, so growing that its stems are often under water in flood-time. There, in May or June, it displays its platter-like clusters of porcelain-white flowers, supported above the vivid greenery of its newly expanded foliage. Later, on the approach of autumn, more conspicuous still, so long as the birds allow, it is jewelled over with clustered fruits, all ruby-red and brilliant.

From the base it puts up several long and slender stems, a little straggling, the twigs of which are smooth and polished, yellow or brown in colour. The buds, in opposite pairs, are oval, rather fat and pointed. Each is enclosed in what appears to be a single scale, formed, however, by the fusion of two, bright red in colour, and slightly sticky. The leaves, which are generally rounded at the base, show three or five angular divisions, into each of which a strong rib passes. Each rib radiates from the place of junction with the stalk, and terminates in one of the leaf points. The margins are irregularly toothed. The leaf is thin and smooth, without hairs above, and with few on the under side. At the top of the leaf-stalk are two or more reddish honey-glands, similar to those on the Cherry. At the base of the stalk are two narrow stipules, which also have honey-glands. Lord Avebury suggests that these glands serve a useful purpose in attracting ants and wasps as a protection, or bodyguard, against inroads of caterpillars, especially whilst the leaves are young. In the autumn the leaf colouring is various, and particularly rich, with shades of yellow, pink, maroon and crimson.

The flowers, which are a very clear white, are grouped and flatly extended as those of the Elder. They are borne

LEAVES OF WILD GUELDER ROSE.

FLOWERS OF THE WAYFARING TREE.

at the ends of the shoots. Each has five petals. Only those central in the group are true flowers and have stamens and pistils producing fruit. These, crowded together, are ringed round with sham flowers consisting of greatly enlarged petals, but petals only; an arrangement not found elsewhere among our trees or shrubs, though similar to that of the garden Hydrangea. The one purpose of this outer ring of sham flowers is to render the whole cluster more conspicuous. These enlarged petals act as signal flags for the guidance of insect visitors. Bees come mainly for pollen, but numerous flies sip from the exposed honey store. The Snowball Tree of the garden differs only in having all its flowers sham; all, and not an outer ring merely, exhibiting enlarged petals, lacking vital organs, and producing no fruit. The fruits of the wild shrub, gathered into a rounded cluster, are stone fruits, each with a single stone. Their brilliant ruby ripeness is all too quickly effective, to our liking, in attracting the birds, to the entire despoiling of this shrub's autumn adornment; but the plant's racial necessity is best served thereby through the assured dispersal of the seeds.

THE WAYFARING TREE

Nominally a tree, this can never rank as more than a shrub, though under favourable conditions it may attain a fair height. Closely allied to the preceding, and sometimes spoken of as the Mealy Guelder Rose, it shows marked differences. It loves the drier places, and is usually abundant and flourishing on the chalk. Its general appearance is dusty, and for this reason, perhaps, the title "wayfaring" has been attached to it, as also that of "mealy." Its main stems grow more nearly upright than those of the Guelder Rose, and its stouter twigs, thickly felted with grey hairs, stand out stiffly to right and left.

The buds, in opposite pairs, have at first two tiny scales, but these fall early, so that practically throughout the whole winter the folded leaves are quite unprotected except by their dense hairy coating. They are long and narrow, and are pressed up against the twig; the form and veining of the folded leaves are quite apparent, and there is even the commencement of a stalk, though not so pronounced as in the buds of the Alder. Terminating some of the twigs are the large, rounded flower buds, or flower-bud clusters, each cluster attended to right and left by an upstanding leaf bud.

FRUITS OF THE WAYFARING TREE.

The leaves are a broad oval, frequently heart-shaped at the base, and pointed at the apex. They are supported by a single midrib with branching secondaries. Their surface is wrinkled, they are thick and velvety, greyish and dusty looking, especially on the under side, where the hairs are thickest. The marginal indentations are regular, like the teeth of a saw. The five-petalled white flowers form a rounded cluster after the manner of an inverted saucer. These are all true flowers, complete in all their parts, none being set apart for purpose of show merely. The fruits, which become considerably bunched, are semi-globular, each being flattened somewhat like a flask. They show great variety of colouring, according to their stage of ripeness, and the incidence of the sun's light, ranging from creamy yellow to coral pink, through crimson to jet black, all in the same cluster. The birds show them marked attention.

LEAVES OF THE WAYFARING TREE.

HENRY IRVING.

THE HOUSEKEEPING OF THE HUMBLE-BEE

"Humble Bees are the least civilised of all communal insects"

By HAROLD BASTIN

Illustrated from photographs by the Author

THE hive of the Honey Bee has often been likened to a well-ordered city. The Humble-Bee's nest is a mere establishment—a kind of insect Rowton House. Its internal arrangements are marked by extreme simplicity, while its inmates have a happy-go-lucky way with them which contrasts strongly with the well-ordered activity of the Honey Bee. Humble-Bees, in fact, are the least civilised of all communal insects. Less civilised are they than the Wasp, although in some respects their habits resemble those of the latter insect.

Like Wasps, the founder of a Humble-Bee colony is a solitary queen, the survivor of the preceding summer, who comes forth from the crevice in which she has hibernated. But whereas Wasps have a definite system of architecture, Humble-Bees have none. Always the interior of the nest presents an irregular appearance.

In Britain we have some eighteen species of Humble-Bees. Some of these build their nests in holes, others upon the surface of the ground beneath a pile of moss or vegetable débris. In all cases, however, the same easy-going methods are in force; so that while the following remarks refer chiefly to a subterranean nest to which the writer paid particular attention, they will also be found to apply, in the main, to such nests as are built upon the surface of the ground.

ENTRANCE TO THE HUMBLE-BEES' NEST.

The home of the Humble-Bee is approached by a tunnel leading into a chamber almost filled with a domed mass of vegetable refuse brought thither by the insects in order that their abode may be dry and free from draughts.

Sometimes this packing of moss, grass and leaves is absent; but in these cases the Bees protect themselves from the possible intrusion of wind and water by stopping up crevices with a waxy material of their own making. In the centre of the chamber is the nest proper—a mass of yellowish objects not unlike small snakes' eggs. These are the cocoons, or cradles, formed by the Bee grubs prior to their period of pupation. At first glance these seem to be huddled together in a sort of hopeless confusion, but a more careful examination reveals a rough and ready method in their arrangement. We notice that the cocoons are in two or three layers. Those forming the foundation have their domed tops removed. Some are empty, but others are filled with a clear liquid which, on being tasted, proves to be honey. The cocoons of the upper layer or layers are completely closed. In each of them a Bee pupa reposes, awaiting the season of its final transformation. The photograph reproduced on page 807 will enable the reader to appreciate the above description.

Winding passages traverse the mass of cocoons, enabling the adult Bees of the colony to pass to and fro about their business. But at first we detect no sign of eggs or grubs—the rising generation, whose presence is naturally anticipated. A closer inspection, however, shows us certain masses of chocolate-brown substance heaped upon the summits of the upper cocoons. The position of several of these masses is indicated

IDEAL SECTION THROUGH HUMBLE-BEES' NEST.
Showing entrance tunnel (A), packing of vegetable refuse, comb of cocoons, etc.

in the accompanying photograph by arrows (p. 807). The smaller heaps each cover four or five shining white eggs; the larger heaps as many hungry grubs.

These strange nurseries are characteristic of Humble-Bee housekeeping. We all know that hive Bees rear their grubs in hexagonal waxen cells, bringing food to the little gaping mouths, just as birds feed their nestlings. But the rough and ready Humble-Bee follows another plan. Let us carry our minds back to the early spring-time, and witness in imagination the origin of such a nest as the one we have depicted. The queen-mother, newly come from her winter hiding-place, seeks out a suitable cavern—her choice often falling upon the deserted home of a field mouse. She then sallies forth to collect pollen and nectar from the flowers; and certain vegetable materials from which she is able to concoct the waxy substance which she employs in cell-making. She then returns to her chosen cavern, and commences to form a waxen cell, roughly spherical, the inner walls of which she coats liberally with honey-saturated pollen. Several eggs are now laid in the cell, which is then completely closed. The queen's next care is to construct one or two waxen tubs, which she subsequently fills with honey. These reservoirs are drawn from to feed the grubs, especially on rainy days when the queen-mother is unable to gather nectar direct from the flowers.

Not long after the young grubs hatch from the eggs they consume the whole of the food with which their cell is lined; and then the queen-mother conveys more food to the interior by ejecting it from her mouth through a hole made for the purpose in the side of the cell. Moreover, the industrious creature, still labouring alone, forms other cells, and deposits more eggs within them. Yet all the time she must busy herself in collecting food for the young grubs which have already hatched.

As the grubs in each cell increase in size, they push against the soft, waxen walls around them, so that the cell gradually grows into an irregular truffle-like mass. When full grown, each grub spins for itself a cocoon of exceedingly fine silk. These cocoons are spun within the remains of the cell; and the queen-mother (later, her assistants the workers)

scrapes away the wax by which the cocoons are covered. This makes it easy for the mature Bee to escape from the cocoon when its metamorphosis is complete.

The lower photograph on p. 808, which is considerably magnified, will give an idea of the appearance of the Humble-Bee's egg, and of the grub (or baby Bee) during several of the earlier stages of its existence. The upper photograph (proportionately enlarged) shows us the dorsal view of the Humble-Bee pupa. One is able to distinguish the larger divisions of the body—head, thorax, and abdomen; also to note that the wing rudiments are folded at the sides, towards the ventral aspect of the pupa, just as is the case with a butterfly chrysalis. Later on, when the mature Bee rubs off the thin pupal skin which enshrouds it, the wings will expand, harden, and assume their dorsal position.

In favourable circumstances the development of a Humble-Bee, from egg to perfect insect, occupies from three to four weeks, so that about a month from the commencement of her labours the queen-mother will be surrounded by a little band of four or five workers, each ready to bear its part in the labours of the day. As week after week passes, these workers increase in numbers. The colony begins to prosper. The queen lays more eggs. The workers go abroad and return laden with pollen and honey. Yet a colony of Humble-Bees is never very numerous, even in the height of its prosperity. In the case of a subterranean species, the nest may contain from 300 to 400 individuals—an insignificant number compared with the population of a Bee hive or even of a Wasps' nest.

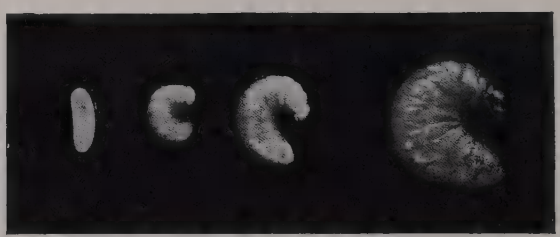
The social "castes" of the Humble-Bee are far more complicated than is the case among more highly civilised Bees. Normally, the inmates of a hive consist of a queen (or egg-laying female), drones and workers, or imperfectly developed females. But among Humble-Bees the fertile females, or queens, are not rigidly distinguished from the workers. The Bees which are hatched from the first-made cells consist largely, if not entirely, of the worker class. But when a colony has become established, numerous small

COMB OF COCOONS (ABOUT NATURAL SIZE).

The empty cocoons from which young Bees have emerged are used as honey pots. The snail shell was built casually into the nest.

queens are often produced; and these supplement the efforts of the original queen in egg-laying—as, indeed, do certain of the workers on occasion. Again, the workers vary much in size, and it seems that their avocation is bound up with their muscular proportions. For observation seems to show that while the larger workers go much abroad in search of food and nest-building materials, their smaller sisters scarcely ever leave the nest, where they pass their time in feeding and otherwise caring for the grubs. In a word, the population of a Humble-Bee's nest in the height of summer consists of individuals of many sizes, whose callings and occupations differ widely. At the approach of autumn, a brood of drones, or males, is produced, as well as a number of large queens—the latter being destined to survive the winter and perpetuate the species during the succeeding year.

HUMBLE-BEE PUPA—UPPER SIDE (MAGNIFIED).



THE EGG AND EARLY DEVELOPMENT OF THE HUMBLE-BEE (MAGNIFIED).

The cheery, easy-going nature of the Humble-Bee is reflected in the fact that the honey tubs are never sealed up, but are free for all who hunger to take their fill. In good weather a prosperous colony will amass much honey. This, as we have already seen, is stored for the most part in the empty cocoons, some of which are built up or altered for the purpose. But the Bees also make additional honey pots of the pseudo-wax (formed from an agglutination of vegetable matter) which they are able to produce. This substance is not wax such as the hive Bees make. It is not plastic to the fingers; while it burns, leaving a carbonaceous residuum which readily attracts moisture.

In the limits of a short article it would be impossible to enumerate all the points of interest connected with the life story of the Humble-Bee. But one or two additional facts may be recorded which seem calculated to inspire in the reader a desire to investigate more fully the habits of these interesting insects. The "tongue" of the Humble-Bee is of very great length, and because of this the insects are of importance to agriculturists, as they are able to probe the depths of certain flowers from which short-tongued insects (such as the Honey Bee) cannot suck the nectar. For instance, Humble-Bees alone visit red clover and effect its fertilisation. It has been suggested that certain moths may also fertilise red clover flowers; but Darwin, who devoted much time to the study of this question, expressed the opinion that it seemed doubtful whether the weight of the moth would prove sufficient to depress the wing-petals of the flowers. He added: "We may infer as highly probable that, if the whole genus of Humble-Bees became extinct or even rare in England, the heartsease (another flower favoured by Humble-Bees) and the red clover would become very rare or would wholly disappear." Strangely enough, this speculation has been shown to be something more than a mere scientific pleasantry. In New Zealand, when first the red clover was introduced, it was found impossible to fertilise

it. Living Humble-Bees were actually imported into the country, where they have now established themselves, with the result that the cross-fertilisation, and consequent seed-setting, of the clover is duly accomplished.

In conclusion, a few words may be added as to the best means of studying Humble-Bees. The reader (for his own comfort) may bear in mind the fact that, although Humble-Bees possess stings, they are by no means aggressive in the use of these weapons. Thus, the taking of a Humble-Bees' nest need not be regarded as a formidable matter. First mark down your nest during the hours of daylight. If you see a succession of Humble-Bees entering or leaving a hole in a bank, you may be assured that this hole is the entrance to their home. Humble-Bees usually cease work a short time before sundown; so that if you return to the spot just before dusk, you may be sure that most of the Bees will have entered the nest for the night. Bring with you a good-sized cigar box, a bottle of chloroform, a pair of forceps, and a gauze-covered, wide-mouthed bottle. You will also need a trowel to lay bare the nest. As soon as possible, pour a little chloroform over the nest, and wait until the humming has ceased. Then push aside the mass of vegetable refuse which covers the comb and gently pick up the stupefied Bees with the forceps, putting them into the bottle. The nest should then be carefully raised and placed in the cigar box. Now put the Bees also into the box, where—if the chloroform has been used with reasonable moderation—they will soon revive.

Before taking the nest, a sheet of glass should be substituted for the lid of the cigar box, while a hole about one inch in diameter should be made in one end through which the Bees may come and go. It is a good plan, however, to stop up this hole for twelve hours or so after the Bees have been placed in the box, in order that they may become accustomed to their new home. Thereafter, the box may be fitted below a window-sash so that the Bees pass in and out without annoying the observer, who remains in the room. In this way an interesting object lesson is provided, the fascination of which will continue throughout the whole summer.

THE THREE KINDS OF INMATES OF A HUMBLE-BEES' NEST.

Left: A typical "worker." Centre: The "queen," or chief egg-laying female. Right: A "drone," or male.

THE AGE OF INNOCENCE: FOX CUBS AT PLAY.

WOODLAND STORIES

A Dialogue between a Cuckoo, a Fox, and a Rabbit

By S. L. BENSUSAN

With Photographs by C. Reid. Wishaw

HAD you been in the Heron Wood just then you might have seen a bird no bigger than a fieldfare winging a curious hawk-like flight from the lone elm in the lane. He passed high over the beech trees that edged the cover, swept down over the riot of alder and briar, and lighted at last on the pink thorn by the side of a patch of clear green sward. There he swayed on the branch he had chosen and listened for a moment. High above him the lark's song fell in a shower of golden notes, in the heart of the greenery a thrush sang to his mate. The bees contributed their quiet undersong to the harmonies above and around them, the spirit of April was brooding over the land. "Cuckoo!" cried the stranger gladly, "cuckoo!"

From a hole in the sandy patch of ground that passed between the green sward and the bushes a sharp little face peeped out, as though in answer to the call, and a small fox cub, owner of staring eyes that had not been open very long, came into the open and sat down on his haunches. He was followed slowly by three sisters, his equals in size but not in confidence. They remained close to their earth, standing on all fours with heads down, and looked for all the world like balls of yellow-red fluff.

"Now I have an audience," said the Cuckoo, who was well pleased with

himself, and he called again, several times.

The grass snake that had been sunning himself on the bank was not quite sure that the cry boded him any good; his family had been persecuted for generations, and he felt it was impossible to remain where he was with any sense of security. So he glided away through the grass and was lost to sight. But Mrs. Doe, the wife of a Buck Rabbit who lived in the warren, came out of her stop a few yards away from the Foxes' earth, and her eight little ones followed. The wild parsley was still within reach of their teeth, and they had recently learned to use them. So they started to nibble the green stuff, keeping close to Mrs. Doe the while.

"Cuckoo!" repeated the bird in the pink thorn. "How are you all? I've come a long way over the sea to visit you."

"Did you see any men or dogs about, sir?" said Mrs. Doe, anxiously. "I've a young family, and I know what trouble is. One can't be too careful here."

"The men are working in the big field behind the brook," said the Cuckoo; "I saw them as I passed, but they did not look up, they were too busy hoeing. There are no dogs nearer than the farmyard, and they are on the chain."

"Thank you, sir," said Mrs. Doe; and then turning to her children she added, "If I stamp my hind legs on the ground, run back to the stop as quickly as you can; don't stay to ask questions or to look about you."

"What is trouble?" said the young Fox, "and where does it come from, and what does it look like?"

"Where are your parents?" said Mrs. Doe anxiously, as though ignoring his question.

"Down in the earth behind me," said the Fox Cub. "Father brought home a nice big chicken, and mother brought some rats for us, so we all had a good meal, and now father is fast asleep. Mother is watching by his side, but she said she wouldn't come out much before sundown because she is so tired."

"They know what trouble is," said Mrs. Rabbit, "and you will learn all about it some day. Wait till you are just a little older."

"This isn't the time for trouble,"

A LITTER OF FOX CUBS.

cried the Cuckoo, swaying on his bough; "the birds are building, and the sun is shining, and the flowers are covering the meadows. When I come from over sea there is no trouble in the countryside. April is here; she and I are old friends."

The Rabbit thought of the chicken and the rats that had provided the Fox family with an early breakfast, but said nothing. Perhaps she felt the intoxication of her first spring—she was not yet a year old.

"Why aren't you in the warren under the bank?" asked the Cuckoo in a lower voice. "If you're afraid of trouble, why do you bring your family next door to a Fox earth?"

"We does must go from the warren when a family is coming," explained Mrs. Rabbit. "If we stayed there our young would be trampled on, and we should never be allowed to look after them in peace. Big buck rabbits are so careless and so thoughtless. So we leave the family house and make a stop not far away. When the youngsters are able to look after themselves we shall all go back, unless we take a great liking to this spot. If we do, the children and I will burrow fresh holes. The land here is rather light, though there is heavy clay outside the cover. I scraped out my stop in a day and a night."

"It's odd that you should go away in that fashion to bear and rear your young, for that is just what the great big animals of my winter home do," said the Cuckoo. "The giraffe and the elephant and some of the deer follow the same practice. But what about the foxes next door to you?"

"They leave rabbits alone now," explained Mrs. Rabbit, lowering her voice in her turn. "I was born here, and brought up with them, when I was no bigger than my babies. There has always been a Fox earth here. I think it's all right, and that we are safe—as safe as any rabbit can be."

The baby Rabbits had gathered courage, they had eaten all they wanted, and were attracted by the Fox Cub's fluffy little sisters, to whom they ambled rather clumsily. The Fox Cub ignored the intruders. He felt too grown up to interest himself in their gambols. And he wanted to know all about the world—the spirit of curiosity had come to him at birth.

"Have you been right across the field?" he asked the Cuckoo.

"I have taken many a long day's journey over land and sea," replied the Cuckoo proudly; "from forests I could not fly across in a morning, and strange sunny lands where men are black, and white folk are seldom seen."

The Fox Cub was silent and a little confused. He knew nothing about seas or men, white or black, but did not care to say so. So he snapped at a busy fly that would buzz round his nose, and then scratched his ear with his paw. He hoped to go out with his father soon and see the world for himself. Already he found it dull to stay in through the night while his father was away hunting, but his mother would not let him leave her side.

"Hush!" cried the Cuckoo suddenly, "some one is coming." He slipped back amid the foliage. The mother Rabbit stamped her hind legs, the little Rabbits scampered back, their parent followed them to the edge of the stop where she crouched, but the Fox Cub and his sisters did not move. They had yet to learn the meaning of fear. The greenery was parted at the far end of the sward, and a keen-eyed horseman looked across the clearing. His face brightened as he saw the cubs; he counted them twice, stared round the cover very carefully, and then, quietly turning his horse round, rode away. A moment later the Cuckoo emerged from cover and Mrs. Doe from her stop. "What was it?" she asked nervously, keeping an anxious touch upon the little ones who clustered round her white tail.

"It was something very big," explained the Fox Cub calmly, "bigger than the bush, and it moved. But when I showed my teeth it turned round and went away." He felt greatly encouraged by the incident. Clearly he was a person of importance, and inspired fear in things much larger than himself.

"If it has gone," said Mrs. Rabbit, "we are quite safe, and I'm very hungry." She moved forward into the long grass that nearly covered her little ones, but her white tail stood up like a flag above the rising growth, and they followed that.

"NATURE RED IN TOOTH AND CLAW."

The Fox Cub's sisters ventured a little way from the mouth of the earth; between them and the Baby Rabbits there was an attraction that neither could resist for long. They sidled up to one another gradually, sniffed curiously at each other's fur, and were soon playing merrily, just as though they had been kittens.

On a sudden the Vixen showed her cunning head at the mouth of the earth, Mother Rabbit drummed with her hind legs on the ground, and six of the little rabbits ran helter-skelter to cover. The other two crouched low for a few seconds, and only raced to the stop when the path was clear of their brothers and sisters. Their mother crouched by the edge of their home. Apparently there was no occasion for uneasiness. The old Vixen smiled from ear to ear. "Pretty dears,' she said; "enjoying a romp with my little ones, too. And not half-grown up yet, the darlings," she added, licking her lips. So saying, she slunk away into cover in the direction of an outlying farm that was full of rats. She had been there once or twice every day since her litter had learned to eat flesh.

"Cuckoo!" cried the bird in the pink thorn, "how nicely she talks, to be sure! I wonder what mischief she is after now. She would not have moved off so contentedly had she known that anybody had seen her cubs."

A splendid dragon-fly hovered on shimmering wings over the Fox Cub, and he tried hard to catch it. Presently it darted away to the far end of the grass, and he ambled after it. His three sisters followed him, and the Baby Rabbits joined them. Then the dragon-fly rose high into the air and passed out of sight, and all the little Fox Cubs sat up on their haunches and strained their eyes into the blue above them. They were very sorry to lose a new playmate.

"Have you a deep hole down there?" said the Cuckoo to Mrs. Rabbit.

"It's a four-foot slope with a turn up into the bed-sitting-room," she replied; "and I've lined it with my own fur until it is as warm and comfortable as one could wish a home to be. I had my family down there nearly a fortnight before they could lift their ears or open their eyes. It was a great joy to find them learning to feed themselves."

"Dig on, dig down!" sang the Cuckoo,

swaying his body to and fro. "I'm an old bird, twice as old as you are. I know the world, and you don't. Dig down, dig on, dig deep," and with these words of warning he flew away, to be mobbed by a company of finches as soon as he reached the open, because they thought he was a hawk.

Mrs. Rabbit sat for a moment thinking as deeply as a rabbit can. She was trying to guess what the Cuckoo meant, but soon gave up the effort, for she saw some delicate grasses a few yards away. She ran forward with a strange haste and fed heartily, looking round now and again to where Cubs and Baby Rabbits were still playing lazily or basking on the green sward. Then her quick ear caught the sound of a cracking twig; she called her little ones to her side and ran for home just as the Vixen returned carrying two dead rats in her mouth. The Fox Cubs ran to their mother, who watched them fight over the dainties and tear them to pieces, but it was a sight that could only have pleased a fox. Mother Rabbit did not like it at all, there was a certain ugly significance about the action that frightened her. She kept her little ones from all view of the proceedings, and, as they would persist in scrambling to the mouth of the stop, she turned round and pushed them before her to the warm chamber beyond the sloping passage. Once in the shelter of her warm fur they soon fell asleep.

Night came slowly to the countryside, driving the light before her from the Heron Wood. The nightingale's song was very clear now, so, too, was the wood lark's, and from time to time the blackbird, whose nest was in the holly bush, would pipe a note or two, to show that his voice was in good order. Moon and stars shone bright above the Heron Wood in a steel-blue sky, and the Cuckoo, coming back to the pink thorn that the dew had made more fragrant than before, lent his merry notes to the support of the invisible choir.

"It's time to be up and doing, my dear," said the old dog Fox to his Vixen as he stretched himself; "the youngsters are all asleep. I think I'll work the home farm; there's a lot of young poultry about just now."

"There are some ducks round the pond at Maylands," said the Vixen. "I'll

A TERRIER FOSTER MOTHER.

go there, and if I can't reach them I'll hunt the gorse by Meadowbank for rabbits."

"Why not take the family of rabbits only a few yards away if you don't want to go far?" suggested the dog Fox. "The stop can't be very deep; you could dig it out in an hour and kill the lot."

"Just so," replied the M.F.H. carelessly, as if he had his doubts but did not care to argue the point. "Where did you say you saw that litter of cubs?"

"On the edge of the clearing in the Heron Wood," said the Squire. "The old ones weren't about, so there's no danger of the vixen shifting them, and I've given strict orders that nobody is to go near the place. When cub hunting starts we ought to have a certain find there."

Photograph by B. Hanley.

A YOUNG RABBIT HIDING.

"Not yet, dear," said the Vixen, licking her lips. "I've counted them—eight and the mother. They won't be grown sufficiently for another three or four weeks, and it's well to have some reserve food near home in case of trouble. Let them play with the children until they are bigger," and she licked her lips again, as she followed her lord and master over the dew-drenched grass.

On the verandah at the Hall, the Squire sat with his friend the M.F.H. They were smoking and listening to the nightingale.

"How peaceful everything is!" said the Squire. "There's nothing better than a late April night in England."

"Yes," said the M.F.H. "They always like that bit of light land. Four, you said? That will blood hounds nicely Hark, do you hear that call?"

In the distance the dog fox was calling lovingly to his mate across the deserted fields. "There's an old one," remarked the M.F.H., as he flicked the ash of his cigar over the verandah. "How early the violets spoilt the scent this year," he added after a pause. "And how far away November seems just now!"

S. L. BENSUSAN.

THE LAPWING, OR GREEN PLOVER

By BENJAMIN HANLEY

With a Photograph by the Author

WHEN male blackbirds loudly challenge each other over their choice of a mate, and rooks caw noisily about their nest-repairing, the love-notes of the Lapwings are heard echoing over the fallows, and the birds begin to separate from the flocks in which they have passed the winter to take themselves off in pairs to choose a suitable nesting site. In this selecting they appear to be in no hurry, for one might watch them standing motionless for minutes at a time, seemingly well content to be simply together. When, however, they do decide upon a likely situation, such as a slight natural depression in the soil or a hole made by the hoof of some animal, the actual nest-building takes up little or no time—a few straws and grasses merely being brought together; often, indeed, even these are omitted, and the eggs laid on the bare ground.

THE LAPWING.

Four in number, the eggs are pear-shaped, olive green with blackish-brown blotches. On some occasions there are only three in a clutch, but this is not usual. The young, when hatched, are bonny little things, clad in a black and buff coloured down. They are able to run and feed themselves almost directly, looking like nothing so much as a bundle of fluff on two stilts.

As summer merges into autumn, both old and young gather into flocks, and, later still, their numbers are considerably augmented by immigration from the Continent, until the flocks begin to assume gigantic proportions. In some districts, during the winter months, it is a daily occurrence to see flocks composed of between five and six thousand birds. They are hardly ever still, running up and down the furrows in search of food.

Seen from a distance they appear black and white, but when viewed at close quarters it will be seen that above they are metallic green with purple reflections; crown and crest blackish green, throat and upper breast bluish black, under tail coverts tawny. In summer the face is blackish and white, but in winter it presents a mottled appearance. This is more pronounced in the case of birds of the year.

IN THE WOOD.

From the Painting by E. G. Warren in the Victoria and Albert Museum.

THE GREAT SKUA BROODING.

THE KING OF THE GULLS

"The kingdom of Sea-fowl which the Skua rules with tyrannical might"

By A. J. R. ROBERTS, B.A.

Illustrated with Photographs by the Author

A HEAVING expanse of ocean, calm as the Atlantic can ever be, mirrored a cloudless June sky and glittered in the merciless sunlight. Here and there a flock of gulls rested on the water, preening their gleaming white and pearly grey plumage; a few, still hungry, quartered the ocean on effortless wings like sleuth-hounds in their search for prey. Presently one bird plunges headlong to the sea. There is a splash, a silvery gleam, and in a few seconds the bird flaps somewhat heavily up from the water—to poise and plunge again. Like vultures watching each other, the gulls collect from every quarter. Bird after bird rises from the scattered flocks which melt like patches of snow in the noonday sun—only to re-unite in one whirling snowstorm of birds, hovering, rising and falling over a shoal of fish that has come to the surface. Suddenly from nowhere a dark form appears, gull-like, yet not a gull, a very hawk among gulls. Choosing his victim from afar, the Great Skua steels his wings and devours the space that divides him from his prey. An ominous swish of wings passing close overhead is the summons to deliver the prize; then soaring in one sweep the Skua checks his headlong rush and prepares to receive his tribute. In vain his victim gulps down his catch and tries escape—the winged fury is on him. Dodge, double and swerve as he will, he cannot shake off his pursuer. Once more the relentless rush, but this time the taloned feet are lowered to strike. One blow is enough;

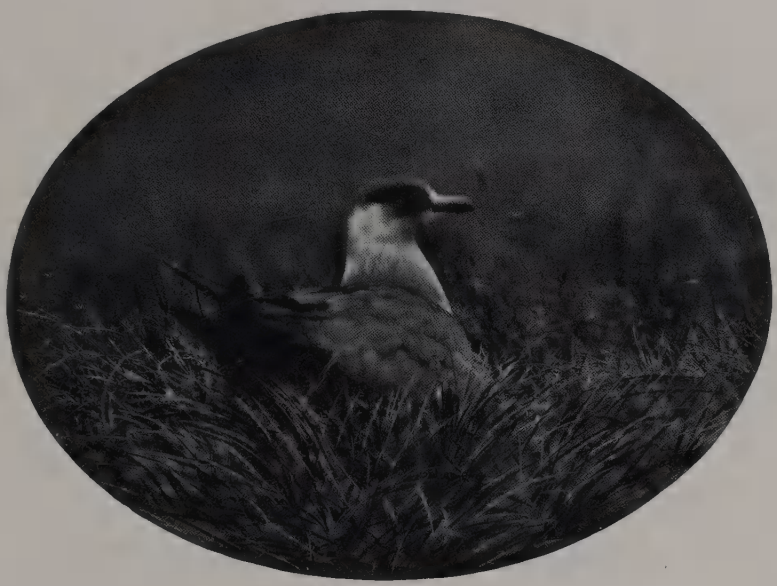
the gull pauses an instant in its flight, and the disgorged fish falls shimmering to the sea. Swift as a hawk the Skua stoops with half-closed wings, overtakes and seizes his ill-gotten meal before it reaches the water, then with leisurely flight he wings his way back to the island mountain, looming purple on the horizon.

A "sixern" boat, a veritable model of the old Viking ships, manned by a blue-eyed, fair-haired crew, whose names bespeak their Norse origin, is the sole connecting link between the island of Foula and the mainland of Shetland and civilisation. Weekly in summer, and fortnightly in winter, weather permitting, it crosses the fourteen miles of perilous tide-race to the township of Walls, carrying the mails and fetching a slender supply of provisions or an occasional passenger. The seas run mountains high whenever the breeze backs against the tide, but fortunately the seamanship of the old Vikings has descended with their blood, and the boat rides lightly as a gull. On opening Vaila Sound Foula comes into view, purple with distance, its fantastic contour cleaving the sky as with mammoth teeth, or else wreathed in cloud as though to hide the spot where, more than a thousand feet above the sea, the Great Skua has made its home.

AN EXTRAORDINARY CLUTCH OF RICHARDSON'S SKUA'S EGGS—TWO IS THE USUAL NUMBER.

Imagine an island, roughly pear-shaped, some three miles long and rather more than two wide, which boasts three mountain peaks all more than 1,200 feet high, yet rising so abruptly that their base is not co-extensive with the coast. Along the eastern side there is a strip of comparatively flat, low-lying land, gradually increasing in width till it includes the whole southern tail with the exception of the Noup, a sugar-loaf hill 800 feet high. Approaching the west coast from the north the cliffs rise rapidly, till they form one mighty rampart where for a mile there is scarcely a point less than 700 feet high, the whole culminating in the Kame, the highest cliff in Great Britain, which falls sheer, with but one slight break, more than 1,200 feet into the Atlantic. People the whole with vast colonies of kittiwakes and armies of guillemots, cover the slopes with puffins and razorbills, distinguish the fulmar amidst the flocks of herring and lesser black-backed gulls by its indescribably graceful flight, search the lower benches for colonies of cormorants and the caves for the shag, and then perhaps you have some slight idea of the kingdom of sea-fowl which the Skua rules with tyrannical might. Here Nature works out her own problems undisturbed, for man is powerless to interfere. On these same cliffs the peregrines rear their young on the sea-birds' flesh, and the raven has its home where no human eye has ever penetrated; but these are, as it were, accessories, accidents; it is the Skua, the buccaneer of the air, which dominates the whole and embodies the spirit of the island in his fierce, untamable character.

Ornithologically, as well as geographically, the island is divided into the lowlands, where the Richardson's Skua (or Allon, as Foula folk say) breeds, and the hills, where the Great Skua (or Bonxie) reigns supreme. The territory occupied by the two species has, of course, no definite boundary, but there is a wide belt—a sort of no man's land—dividing the two. Well were it for the Allon if it did occupy the lower parts of the hills, for on the level ground it is too much at the mercy of the storm. My first day on Foula gave me an insight into the constant struggle against the varied forces of Nature which is the life of all wild creatures. No quarter is asked for, none can be given. Might is right, and sooner or later all fall in the fighting line; for there is no gradual decline and peaceful death for any other than man. A gale hitherto unchecked in its course over the Atlantic was wreaking its fury on the island. The wind shrieked and raged over the treeless ground, and the rain descended in hissing torrents, which seared the hillsides with an infinity of tiny channels and swamped the level parts. Numbers of Allon were standing, like so many weathercocks, with their heads to the wind; in a few instances the motherly instinct triumphed and they crouched in an endeavour to shield their young; but most were left to seek shelter as best they might, for in the warring of the elements it was each for himself. Here and there I found hollows which had been nests and now were pools in whose midst the eggs rose as twin islets. In one case the egg-shell was broken and the beak of a young bird protruded, meeting death on the threshold of life, drowned before it really was born. Other chicks, older and stronger, had strayed away from the treacherous hollows of the nests and sought shelter from the stinging rain behind tufts of grass. For such as I found I built little shelters, but the parent birds mistook my attentions, and, rising into the storm, they swooped down upon me, striking my head with feet and wings, attacking me now from one side, now from the other so rapidly that one could not but marvel at the ease with which they set their wings like reefed sails and harnessed the very violence of the gale.



RICHARDSON'S SKUA SITTING.

During the night the storm spent its force, and the next morning saw me on my way to make closer acquaintance with the Bonxie. The day promised fair, but just as I reached the summit of the

hills thin, filmy wreaths of vapour gathered and thickened as I watched, blotting out the world below and limiting my horizon to a circle of some thirty yards diameter. However, I went on—cautiously, for a precipice more than a thousand feet yawned not far off, and it was soon impossible to say in which direction. On all sides I could hear the subdued roar of the surf, puffs of wind drove the mist in diametrically opposite directions, and overhead from time to time I heard the hoarse cry, "Squa, squa," from which the Skua derives its name, but as far as sight was concerned I was the only living creature on the roof of the world. The ground was covered with long, coarse grass, and presently, all unknowing, I approached the spot where a young Bonxie lay hidden. There was a roar of a body rushing through the air, a great expanse of wing brushed past my head, vanishing into the cloud, and again I was alone. Thus warned, my search became more systematic, and soon I discovered the young bird—fat, yellow and downy—crouching in the grass, and though the light was bad I attempted to take his portrait. Again the parent dashed down from the cloud in one great sweep, and, reaching the level of my eyes, made straight at me. A powerful, hooked beak and piercing eye, a heavy body lowered to check the downward course, stiff pinions bent with the resistance of the air, clear-edged as though cut out of tin, and rattling as the air rushed through them, black taloned feet ready to strike—that is the picture of the Bonxie photographed in an instant upon the brain. Instinctively I flinched; and the Skua, less than two yards from my face, altered the angle of its wing and skimmed over my head out of sight.

YOUNG OF GREAT SKUA AND PARTIALLY DEVOURED HERRING.

That young bird was an exceptionally bad sitter even for a young one. It bit and tore at the grass, at the tripod, or anything that presented itself. The poor light made a time exposure necessary, and all the while the parents kept up the attack, till familiarity began to breed indifference. At length I moved off, and now that my eye knew what to look for, I had little difficulty in discovering other nests, some with eggs, others with young in various stages of growth. Here and there lay the body of a puffin or the remains of a herring. One never sees

YOUNG RICHARDSON'S SKUA SHELTERING FROM THE RAIN.

A YOUNG GREAT SKUA.

the birds carrying food to their young, and it is practically certain that even the large herrings are first swallowed and then disgorged for the young ones when the nest is reached. It seems incredible that the puffin could be treated in this way, yet their presence has to be accounted for. Clawed though the Skua's feet are, they are webbed and could scarcely grip their quarry as a falcon does, and I have never seen a puffin venture of its own accord inland to trespass on the Skua's domain.

THE GREAT SKUA SOARING AFTER ATTACK.

The Raven alone dares to brave the Bonxie's wrath and even plunder his nest with the characteristic cunning of the crow tribe. His usual method of fighting, or rather of self-defence, consists in turning on his back in mid-air, and presenting his powerful claws, on which his enemy rushes to his own ruin. But even the Raven's confidence in his own powers melts before the Bonxie's terrifying onslaught, and he achieves by stealth what he is denied by force. Alighting on the ground within reasonable distance of the nest he has selected, he crawls along, crouching so close to the ground that the Skua's attack loses all its sting, and submitting to repeated buffeting, he philosophically consoles himself with an egg.

Wandering on, I became aware that each pair of birds had its own special portion of ground. The moment I entered upon their territory they commenced their attack, and escorted me, with their somewhat embarrassing attentions, till I reached the farther boundary, when another pair took up the task. Perhaps one had moments of resentment when the blow was especially severe, but it was easy enough to keep them at a distance by carrying a stick over the shoulder; and, after all, one could not but respect the bold defence of their offspring and pay a slight tribute to the pirate of the air, whom the Foula folk used to prize because he drove off the marauding white-tailed eagles and thus protected their lambs.

A. J. R. Roberts.

HORNED POPPY.

HOW TO KNOW THE SEASIDE FLOWERS—I

By the REV. H. PUREFOY FITZGERALD, F.L.S.

Illustrated with Photographs by HENRY IRVING

ONE of the attractions of the seaside, to one who is botanically inclined, is that a great many flowers may be expected which do not grow elsewhere; it is astonishing how some of them are able to grow at all, as they spring up in places where there would seem to be no soil. Some cliffs are famous for certain rare wild flowers—those in Cornwall, for instance near The Lizard, are especially noteworthy—but with these I do not intend to deal. The plants considered here may be said to be found generally round the coast, and most of them may be expected to turn up on any ramble near the seaside.

HORNED POPPY

The most conspicuous plant that grows on the shores and cliffs around the coast is the Yellow Horned Poppy (*Glaucium luteum*), a stout growing annual belonging to the Poppy family (*Papaveraceæ*). The foliage is somewhat large, of a glaucous or pale sea-green colour; the leaves which come from the root are all stalked and divided, and somewhat rough from bearing short, thick hairs;

those leaves that grow on the stalks are much shorter, and not cut up so much into divisions, they are also smoother. The large yellow flowers (some three or four inches across), whose petals fall so soon after the flower is picked, are borne on short stalks; the petals are four in number, as in all Poppies.

The long, curved, horn-like seed pods are sure to attract the attention of any passer-by; these vary in length from six to twelve inches, and bear at the extreme end the remains of the spreading lobes of the stigma.

SEA HOLLY

The pale sea-green or glaucous bloom is more often to be seen on plants growing near the sea than on those found in more inland parts; another noticeable example being the Sea Holly (*Eryngium maritimum*). The name is given to it, not because it is any relation to the Holly, but because its leaves are very prickly, stiff and sharp pointed. On a cursory examination of the flower head it might be thought to be a member of the Composite family; in reality it belongs to the same family as the Parsley and Hemlock, the *Umbelliferæ;* the flowers are in a compact, globular head, measuring nearly an inch across. The lower leaves are stalked, the others clasp the stem; all of them are somewhat wavy, and they are more or less divided into three lobes at the top, and bordered by very prickly teeth, so that the plant has to be handled very warily. The heads of flowers are pale blue in colour and rest on an involucre of five or six leaves which are smaller and narrower than the rest. The flowering season is during July and August. The generic name (*Eryngium*) is derived from a Greek word signifying that the plant was at one time used as an emetic. Linnæus states that the young flower shoots are very good eating, if they are cooked in the same way as asparagus; the leaves have a sweet, aromatic taste, whilst the roots are sometimes candied, and sold as a sweetmeat. The sandy seashores of our eastern coasts are its favourite habitats; it is an attractive looking plant and one that is very easily recognised.

SEA HOLLY.

SEA ASTER.

SEA ASTER

The Sea Starwort or Aster (*Aster Tripolium*) must be sought for in salt marshes and on the shores of tidal rivers at the end of August or in September; it resembles very closely, both in shape and colour, the ordinary Michaelmas Daisy of our gardens, and it is readily seen to be one of the Composite family. It varies very much in height, generally it is about eight or ten inches high, but sometimes one comes across a plant nearly three feet in height. The leaves are somewhat thick and fleshy, quite smooth round the edges, and have three distinct nerves. The flower heads are generally numerous, the outer florets are blue or purple; in some cases these florets are not very numerous, giving the flower rather a ragged and scanty appearance; the inner florets are yellow.

SEA CAMPION

For some time this plant was supposed to be but a variety of the Bladder Campion (*Silene inflata*); it very closely resembles it in a great many ways, but there are sufficiently distinctive features that have earned for it the right to be considered a separate species, and it is now named *Silene maritima*. The Sea Campion can be distinguished from the Bladder Campion by the leaves being very much thicker, almost fleshy, as is the case with so many seaside plants; the flowers are very large in comparison, being about an inch in diameter, and there are seldom more than three blossoms on a

SEA CAMPION.

plant ; the lobes or divisions of the petals are broad, and the whole plant is smaller and more stoutly built ; a glaucous hue may often be seen pervading the plant. The photograph will show that the Sea Campion possesses the same inflated calyx as the Bladder Campion, this being a noticeable feature of both plants ; it is in bloom during the summer.

H. Purefoy Fitzgerald.

SPIDERS AND THEIR SNARES

By JOHN J. WARD

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," etc.

Illustrated from Original Photographs by the Author

NOT all species of Spiders construct snares in which to entangle their prey. There are many kinds, such as the Wolf Spiders (*Lycosidæ*), and the familiar Zebra, or Harlequin Spider (*Salticus scenicus*), that boldly hunt for their quarry in the open. The Wolf Spiders are frequently seen low down beneath bushes (especially in woods) rapidly moving about amongst stones and fallen leaves; they are fearless hunters, chasing their prey in a fierce and determined manner until its capture is effected. The female Spider may often be seen affectionately carrying about with her the silken sac containing her eggs, which she bravely defends when attacked. When the young are ready to appear, the egg sac is broken open and the young Spiders swarm over the back of their mother in a huddled mass, giving her a very curious appearance, and in that manner are conveyed about by her.

The Zebra Spider is familiar to most people, for on almost every sunny wall and tree-trunk it may be seen hunting its prey. The female is only about one-quarter of an inch long, and the male is less. The lateral white stripes upon the dark-coloured abdomen, and the crafty manner in which this Spider edges up to unsuspecting flies basking in the sunlight, and then, like a flash, springs upon them, readily distinguish it.

The hunting forays made by this Spider are really remarkable performances; it often attacks its prey on the flat bricks of an ordinary wall. It should be mentioned, however, that it takes precaution to guard against disaster. Behind it trails a silken thread, and but for this it would often fall to the ground, together with its victim, during the short struggle that ensues on the capture of its quarry ; sometimes, too, it misses its aim.

The egg sacs are not carried about by the female Zebra Spider, as in the case of the Wolf Spiders, but are hidden in crevices of the bark of trees and amongst the loose mortar in old walls. On a common brick wall, the favourite hiding-place is the narrow groove beneath the coping stones at the summit.

In the first illustration one of these Spiders prepared to exhibit its anatomy is shown enlarged ten diameters. The large and sharp poison fangs (as deadly, as far as the fly is concerned, as those of the cobra) on its head should be observed. These organs are movable, closing inwards in clasp-knife fashion, thus enabling the Spider to hold its victim in close contact with the toothed basal parts while its juices are extracted.

In warmer parts of the earth some of these hunting Spiders assume quite large dimensions. An illustration of one of these is shown at natural size on page 831. This is one of the so-called " Bird-catching Spiders " (*Theraphosidæ*), whose food really consists of beetles, resting moths, ants, smaller Spider species, etc. During day-

light these monster Spiders hide in the hollows of trees, or amongst banana, pine-apple, or palm leaves loosely spun together, emerging from their lairs at night ; while others of the family construct silk-lined tubes in the sand, closed by a circular trap-door, composed of alternate layers of silk and soil. The door fits so closely, and the simulation of the surrounding

A MALE JUMPING SPIDER (*SALTICUS*), DISPLAYED TO SHOW ITS ANATOMY.
(Magnified ten diameters.)

soil is so accurate, that it becomes almost impossible to detect the entrance to the Spider's home during daylight; but at night it is more conspicuous, as the Spider leaves open the door in readiness for a hasty retreat. If attacked it bolts into its tube and clings to the silken lining on the inside of the door, holding by its legs to the sides of the tube ; in this manner it usually succeeds in defending its stronghold from dangerous intruders.

Accounts of these Spiders attacking full grown birds are largely fictitious ; young humming birds and similar small animals are sometimes attacked in their nests, owing, probably, to the fact that the Spider comes upon them while hunting its quarry, and their tender, featherless bodies tempt its voracious appetite. From these free-hunting Spiders we may trace a gradual evolution to those species that weave complex snares in which to entrap their prey. The first use of silk-spinning was for the building and protection of the home, and to ensure safety for the mother and young. This closing of the entrance to the tube or retreat with silk has probably led to the construction of those beautiful and geometrical snares so familiar in gardens and fields all over the world to-day. The enemies of the Spider and inquisitive insects would doubtless get entangled in the entrance web, greatly to the satisfaction of the Spider, which would thus discover a new method of capturing its prey. In due course, guided by the success achieved by this discovery, it would construct more and more complex snares outside its retreat, extending them

ONE OF THE SPINNERETS GREATLY MAGNIFIED TO REVEAL THE MINUTE TUBES FROM WHICH THE SILK IS EMITTED.

to the leaves and stems of plants and other objects; and thus by a gradual perfection of the primitive form in the course of ages may have finally evolved the marvellously constructed snares, with all their complicated details, which are so common where the Spider conducts his nefarious trade.

The snares of the web-weavers are the more astonishing when we consider their details. A glance at the illustration of the web of a Garden Spider (p. 829) will show that the meshes are formed by two kinds of threads. There are, first, the radiating threads, and then woven over these are numerous concentric threads. When the Spider moves about her snare it will be found that, as far as possible, she avoids the concentric threads, for these are contrived with diabolical ingenuity (I use that expression figuratively) for the capture of her victims.

The framework of the snare is composed of plain, strong strands, but the concentric threads are studded along their length with large and small viscid globules (see illustration on p. 830); indeed, the snare is not only a net in which to catch unwary flies, but a veritable bird-lime trap which hopelessly entangles them as they struggle to effect their escape.

Within the abdomen of the Spider are several powerful glands of various forms which secrete the viscid fluid from which the web is constructed. These glands are connected with the spinnerets at the hinder part of the abdomen; an enlarged view of these organs is given on this page.

As the illustration shows, there are six spinnerets in the case of the Garden Spider. Each of these organs is crowned with numerous minute tubes of great delicacy, and from these issue the silken strands. One of the spinnerets is also here shown further magnified to exhibit these tiny tubes. In the construction of a thread, the silk may be drawn from a few or from all of the tubes of a spinneret, according to the strength required.

The silk from the various glands undoubtedly differs in character. I have stated that the framework of the snare consists of plain radiating spokes or strands, and I may now add that, when formed, they harden rapidly on

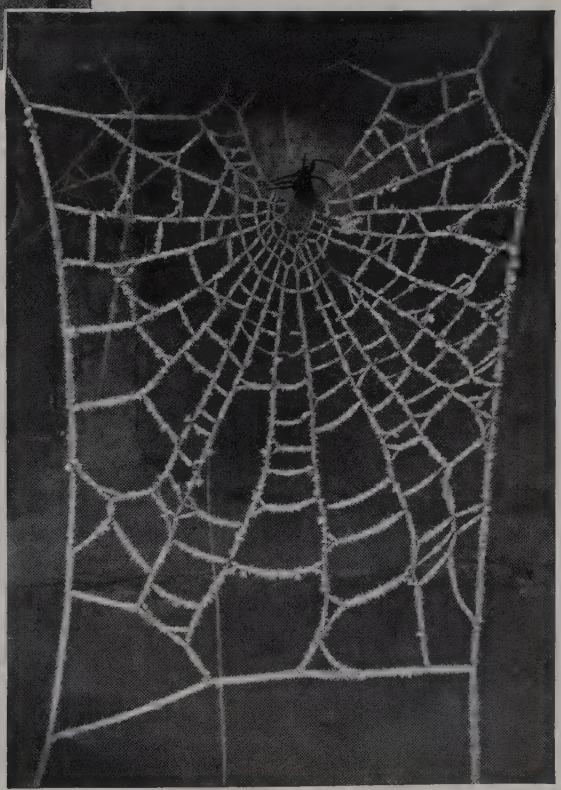
A MAGNIFIED VIEW OF THE SPIDER'S SPINNERETS.

THE SNARE OF A GARDEN SPIDER.

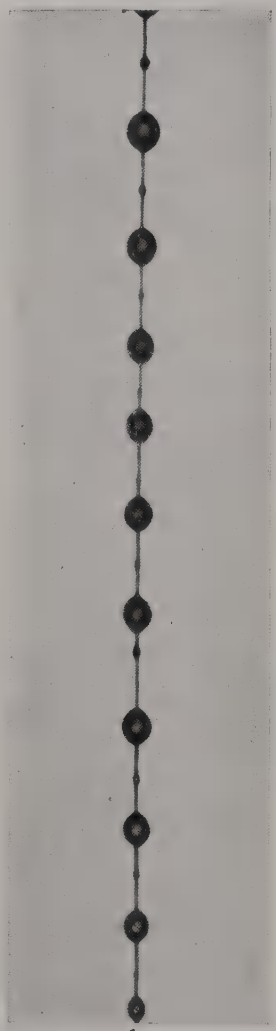
exposure to the air. The concentric threads are also of the same plain structure when first formed, but they do not harden on contact with the atmosphere. When the thread is drawn out, the Spider gives it a sudden tug and then lets go; the vibratory action thus produced causes the formation of the tiny globules, which are generally arranged alternately large and small, as shown in the illustration on page 830; sometimes, however, they are all of one size, and at other times more or less irregular.

Although the Spider may not be seen about her snare, she is nevertheless always in prompt telegraphic communication with her complex trap. The moment an unwary fly touches one of the viscid threads, she immediately appears from beneath a leaf, or wherever she lay in hiding, and before the fly has scarcely had time to realise its situation it finds itself confronted with a fiendlike monster glaring at it with eight bead-like eyes, while below these are a pair of toothed crushing jaws, each one terminating in a sharp and curved poison fang. A pair of large-jointed hairy organs (palpi), one on either side, add further terrors to this appalling face (see illustration, p. 830), as they wave and flourish apparently with malignant glee while the attack is made.

Then the spinnerets are directed towards the hapless victim, and a moment later it is enveloped in a shower of silken strands, spun round and round on the threads that hold it until at last it is firmly secured—still alive—in silken bonds. So the fly is



THE SPIDER'S DOOM—FROZEN AT HER POST.



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1. A PORTION OF THE CONCENTRIC THREAD MAGNIFIED TO REVEAL ITS VISCID GLOBULES.
2. THE COMMON GARDEN SPIDER MAGNIFIED TO SHOW ITS ANATOMY.

left in the Spider's larder, in durance vile, until she needs a meal.

Throughout the summer and autumn months she spreads her snares for prey; occasionally her lovers, and sometimes even the husband of her choice, fall victims to her savage and voracious appetite. The winter, however, usually terminates her butchery; after a sudden and unexpected frost her last snare may be seen conspicuously outlined in white (see illustration, p. 829). Rarely, however, is she then found at her post; more often she is hiding away, endeavouring to keep warm, in some sheltered corner; but hard days have come upon her, and Nemesis is waiting an opportunity to strike.

JOHN J. WARD.

A "BIRD-CATCHING" SPIDER FROM THE WEST INDIES.
(Photographed from life, natural size.)

THE CLEVERNESS OF THE SUNDEW

Showing the devices of a carnivorous plant to catch its prey

By HAROLD BASTIN

Illustrated with photographs by the Author

FEW British plants are more interesting than the Sundews—those lowly but beautiful dwellers in boggy places. Three species are recognised, to wit, the Round-leaved Sundew, the Long-leaved Sundew (both of which often grow together in profusion), and the Great Sundew, which is a more robust plant, but much rarer. The most interesting point about the Sundew is that it catches flies—as everybody knows. The leaves are densely covered with red hairs, each of which is tipped with a drop of viscid fluid. This fluid is secreted by glands that are found at the extremity of the hairs, and the most curious thing about it is the fact that it actually contains a substance which closely resembles the pepsine of an animal's stomach. When a fly, attracted by the brilliant display of the Sundew leaves, alights upon one of them, it is at once captured and held fast as effectually as it would be had it flown against a fly-paper. If one watches a leaf which has just succeeded in catching a fly, one sees that it slowly but surely bends over and grasps its prisoner, bringing its red, hair-like tentacles into position and pouring forth a copious flow of digestive fluid from the glands at their tips. In this way the fly is speedily digested—its juices being absorbed by the plant to supply the nitrogen which, we are told, it is unable to procure in sufficient quantities from the marshy soil in which it grows; and when one fly is disposed of, the Sundew leaf casts the indigestible portions aside and resets itself in preparation for another victim.

Amazing as these facts are, they by no means exhaust the interest of the Sundew. I think it was the American

THREE PHOTOGRAPHS TAKEN AT INTERVALS OF 40 MINUTES.

A fragment of meat was suspended by a hair from a large needle, the meat hanging not far from a fully expanded Sundew leaf. The photographs show how the leaf turned towards, and eventually touched, the meat. It never succeeded in fully grasping the meat, probably because the distance was too great. But how did the leaf know that the meat was there at all?

A FLY CAUGHT BY A SUNDEW LEAF (GREATLY MAGNIFIED).

writer, Mrs. Mary Trent, who first discovered that the leaves of this plant appear to possess a sort of instinct which warns them as to the whereabouts of food. She found that a Sundew leaf would move in the direction of an insect which was placed at some distance from it. In order to verify this record, the present writer attached a minute portion of raw meat, by means of a hair, to a large-sized needle. This needle he stuck into the soil close to a young but fully developed Sundew leaf, which formed part of a healthy plant growing in a saucer. The first of the three photographs reproduced on page 832 illustrates the preliminary stage of the experiment. Subsequently, at forty-minute intervals, the other photographs were taken. These show plainly the manner in which the proximity of the meat influenced the Sundew leaf. In the second photograph of the series the leaf-stalk is bent towards the meat, and many of the red hairs are also stretching in that direction. In the third photograph the bend of the stalk is still more marked, while several of the hairs are in actual contact with the bait. Unfortunately, the leaf had been too severely tested. It never quite succeeded in digesting the meal which it had tried so hard to win for itself. This, I think, was because the bait had been set up in such a position that actually to grasp it the leaf would have had to bend over the axis of the plant. Should the reader wish to repeat the experiment here described, he should so arrange the meat that the Sundew leaf will be able to reach it without having to bend its stalk unduly.

A healthy Sundew plant, transferred from its marshy home to a saucer, will thrive well enough provided that it is kept thoroughly moist and exposed to the sunlight. Indeed, if it is covered with a bell-glass, so that the air around it is kept saturated with moisture, the plant will rapidly send up new leaves and flower spikes. Such a "captive Sundew" will afford limitless opportunities for observation and experiment. What has already been affirmed by various

writers respecting its powers of discrimination may be put to the test. One may prove, for example, that the leaves are very partial to little morsels of steak; and that they will have nothing whatever to do with cinders, bits of moss or straw, or little pills of paper. They do not even trouble to examine such objects with their red hairs or tentacles. The leaves seem to know instinctively whether the substance which falls upon them is good for food; and they refuse to waste time and peptic fluid on substances which possess no nutritive value.

HAROLD BASTIN.

CHAPTERS IN PLANT LIFE

I—THE ASSERTIVE PLANT

By S. LEONARD BASTIN

With Photographs by the Author

ON this crowded earth, one of the chief problems which confront the individual plant is that of finding room to grow at all. Every available space is so thickly tenanted that it is only the very sturdy, or the very ingenious, subject that can hope to hold its own in the great struggle for a position. The appearance of the June meadows is not in the least suggestive of strife, yet on every foot of the ground there has been waged a battle that has decided the fate of a countless array of units. The tall grass heads, and the graceful Moon Daisies, are but the surface representatives of a densely populated world beneath, the inhabitants of which are so closely packed together that it is pardonable to wonder how they can exist at all. Indeed, the overcrowding is such that not a trace of the brown earth is visible in the compact turf formed by the innumerable plants. It is possible to realise how keen must have been the competition for a place when we remember that for each plant which has come to perfection, several score will have gone down in the struggle.

Perhaps some of the most aggressive plants in the capturing of positions are those with subterranean stems, which run along under the soil, sending up shoots at intervals. Not a few of the grasses are marvellous instances of how much space a single plant may cover. The maritime grass *Psamma arenaria*, so common on our coast sand-hills, spreads over a huge area of ground, as may be proved by pulling up one of the tufts. It will be found that the long stem may be traced back for several feet to the parent plant. In a very similar manner does the great Bracken Fern thrust out its rhizomes, or underground stems, in all directions, and in this way occupy the ground to the exclusion of almost everything else. In a very large number of cases, however, the stems are simply procumbent, running along on the surface of the soil. The Speedwells, the Potentillas and the Strawberries are in this way able to monopolise the situation.

In one summer a sturdy specimen will succeed in rooting its leaf joints in dozens of places; these plantlets are doubly strong in that they are not only rooted on their own account, but are still in receipt of assistance from the parent. The chances of seedlings whose lot has been cast near to one of these pushful species are doubtful in the extreme. It is a version, in the vegetable world, of the old story of the small tradesmen with single shops struggling against the great company with its hundred branches, each one of which is supported from a central establishment. Still further to the advantage of the spreading plant is the

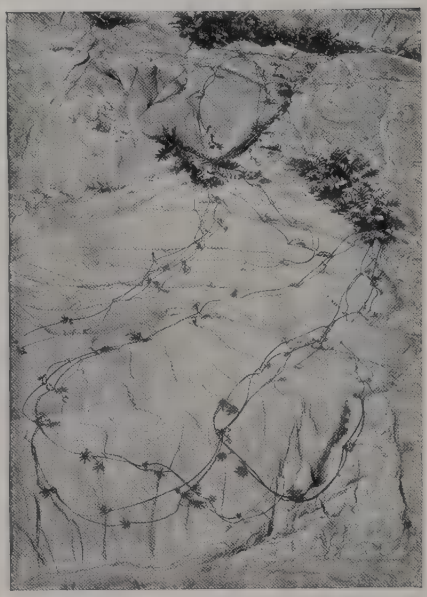
A SPECIES OF HYACINTH WHICH DROOPS ITS LANCELIKE LEAVES OVER THE SURROUNDING SOIL AND SO DISCOURAGES OTHER PLANTS.

fact that if any of the sections should become detached, these enter upon the scene as new individuals, quite capable of representing the race on their own account. A large number of perennials adopt this mode of increase in addition to seed-bearing, and these are to be numbered among the most successful of plants.

There can be no doubt that the large number of species which have resorted to climbing methods have been induced to do so by the ever pressing need for room. That this enterprise has not been in vain is a commonplace fact of the countryside, for it is the Brambles, the Honeysuckles, and the Bryonies which have long since captured the hedges for their very own. Right down in the darkness at the centre of the hedge we may find the rooting-place of these plants, in situations where nothing but a subject that could grow yards up towards the light would possibly be able to exist.

The different methods adopted by the climbing plants to get up in the world are as varied as they are ingenious. Perhaps the most common is that to be seen in the case of the twining species, which by means of their stems twist themselves round a support. Some of these plants, such as the Hop, invariably turn from left to right; whilst others, of which the Bean is a typical example, travel in an opposite direction. The constancy with which each species adheres to its particular habit of growth is very remarkable; no coercion will induce the stem to alter its natural course.

A very interesting experiment may be conducted with a common French Bean plant to illustrate the climbing methods of the species. A young seedling should be secured which has just developed its second pair of leaves. At this stage the short stem is very nearly upright, but as it develops it becomes too slender to support itself. Now comes into operation that curious tendency on the part of climbing plants called circumnutation. This consists in a ceaseless search for a support; round and round the stem



THE POTENTILLAS COVER IN A LARGE AREA BY MEANS OF THEIR CREEPING STEMS.

travels, reaching out farther and farther every time the circle is complete. On a warm day the stem of the Bean goes round at a wonderfully rapid rate. In one case the tip of the shoot traversed a circumference of two feet in a couple of hours, showing that the rate was an inch in five minutes—no mean performance for a plant.

When the circumnutation of the Bean has been fully observed, it is instructive to place a support within reach of the shoot. This should be upright, seeing that as a general rule the twining plants are not able to climb save up a nearly perpendicular object. The attachment to the stick is a matter which is very quickly accomplished, for a few minutes after the shoot is actually touching the tip commences to curl round. As soon as the hold is securely accomplished, the manner of growth changes into the spiral twining by means of which the stem will advance up the support. This is probably related to, if not identical with, the process of circumnutation. The passage of the bean-shoot up the support is now very rapid, and on a close summer's night will be as much as two inches in the twelve hours.

Next in importance to the twining plants are those which clamber up by means of tendrils. These organs are among some of the most wonderful in the plant world. One interesting British plant producing tendrils is the White Bryony, a common hedgerow species. In this case the climbing organs are large, sometimes being as much as four or five inches in length. The means by which the tendrils secure a hold, and then twist themselves into the permanent position, offers a peculiarly fascinating study. Prior to their attachment to any object, the processes maintain a curious swaying movement, which must increase the probability of their coming into contact with a support. Directly the tip of the tendril is within reach of some object it begins to entwine itself without delay. In the space of a few minutes, supposing the conditions to be favourable to rapid growth, the slender thread has started to encircle the support. The underlying cause seems to be partly in the stimulating influence induced by the light rubbing of the under side of the tendril against the object. When the tendril is at its greatest period of activity it may be induced to curl round almost any object which is offered to it.

A pencil, or the little finger, passed gently along the inner side of the organ will cause it to twine around the support; the slight rubbing making the movement a good deal more rapid than is normally

THE NASTURTIUM CLIMBS BY MEANS OF ITS LEAF-STALKS.

THE HUGE LEAVES OF THE SOUTH AMERICAN GUNNERAS COVER IN A LARGE AREA.

the case. As a rule, the tendril is not content with merely looping itself once round the support, but, in order to make quite sure that there can be no slipping away, doubles or trebles the circles. When the attachment has been rendered quite secure, the strange spiral twisting comes into operation. As a rule, the turning goes on in one direction for half the length of the tendril, and in an opposite way for the remaining half.

This coiling business is very interesting to watch, and is started with the formation of a small crank-like process, which continues to make complete revolutions, swinging downwards and upwards with the greatest regularity. As it does this, the tendril is, of course, coiled on either side of the bent portion, in one direction on one side, and in an opposite direction on the other side. When the coiling is completed the small crank-like part will appear as a little straight section between the two spiral portions. At times it is to be noticed that tendrils will develop several series of spirals, and thus there may be two or three of the alternating portions. The spiral conformation, of course, very much tends to strengthen the organ, whilst at the same time it secures to it a certain springiness that will allow a "give" when the plant strains in rough weather.

Not a few plants climb upwards by pressing into service their leaf-stalks; of these, the garden Nasturtiums and the Wild Clematis are examples. Both these species, particularly the latter, contrive to rise to a considerable height by twisting their leaf-stalks round the nearest support. The Ivy has resorted to a still more curious method, and is able to attach its stems to trunks of trees and other supports, by means of its adventitious roots which are so freely produced. These processes serve the double office of climbing organs and also as means of imbibing water; indeed, in very moist weather the ivy will often send out quantities of the white filaments on the side of the stem which is not attached to the support. Finally the common Bramble scrambles upwards by means of the bent hooks with which its stems abound. These enable the plant to catch hold of any surrounding objects,

so that it easily brings its leaves into the lighter position.

It is not only as a climbing species that the Bramble is remarkable; in another way the plant offers a curious instance of resourcefulness. Every wayside patch is adorned with its Blackberry bushes, and one of the reasons for this plenitude of Brambles is to be found in a strange habit which the plant possesses. When, as is so often the case, the Bramble is growing over a pile of stones or rambling up a rough rock wall, it is seen that the plant takes root all over the place. If the lusty shoots which are sent out in such profusion come into contact with a little vegetable mould that may have collected between the chinks of two stones, or even rest for any length of time upon the ground, the points quickly lose their original character. All the features of a growing shoot vanish, and the point, becoming clubbed, eventually sends out roots. Thus a fresh hold has been secured by the aggressive Bramble.

The budding propensities of certain plants are very interesting in the part which they play in helping the species to spread over the surface of the ground. An Indian evergreen shrub belonging to the House-leek family produces leaves which at every notch in the border bear an embryo bud. The species, which is named *Bryophyllum calycinum*, can literally produce a score or more of baby plants from any of its leaves. If a leaf is thrown down on the soil the buds quickly develop into perfect little specimens. A North American fern is perhaps even more curious. This is a species of Hart's Tongue (*Scolopendrium*), and has been called the Jumping Fern, on account of its strange habit. As a rule, the buds of this species are produced at the tip of its lance-shaped fronds. These fronds, being very long and slender, trail over until their tips touch the ground, when, if the soil be in a moist condition, roots quickly form on the under surface at the point of

MANY SPECIES HAVE A HABIT OF "STARRING" OUT, AND IN THIS WAY DISCOURAGE SURROUNDING GROWTH.

THE PRETTY PATTERN FORMED BY THE DWARF PLUME THISTLE.

contact, and from the upper surface new fronds arise.

It is certain that plants do all in their power to discourage their neighbours. The struggle for a place is so severe that it is a case of everyone looking out for himself. It is to be observed that many species have a striking tendency to cover in as much space as is possible with their leaves. Perhaps one of the chief reasons for the evolution of large foliage is that thereby the subject can more readily hold an unhampered position. In some ways big leaves carry with them great disadvantages; they are readily damaged, whilst a comparatively long while must elapse before they can be replaced. Again, the big surfaces they offer may at times bring about a more speedy evaporation of moisture than is desirable. But to balance all this, the large-leaved plants are never likely to be in difficulties for want of room, simply because their overshadowing growth will smother all the adjacent species.

Consider the position of seedlings coming up among the stems of a good-sized Dock. Completely sheltered from the light and air by the great leaves, there is not the slightest chance that they could ever come to perfection. In pulling aside the foliage of any large Dock plant we may find the remains of the unfortunate seedlings which have perished under the sheltering leaves. The British Dock is quite a pigmy beside the great American Gunneras. These plants, which in their appearance are suggestive of vast rhubarb, produce leaves that are enormous. Borne on long, stout stems, which are at times as much as ten feet in height, the great leaves spread out in a canopy that keeps an immense area of ground in perpetual shade. The shelter which the leaves afford may be realised when it is stated that not infrequently the huge organs are six feet across.

Very much the same kind of thing happens in the world of trees. When one sees the enormous crop of acorns produced by the Oak, and watches the myriads of Sycamore seeds which flutter to the ground in the early autumn, it is difficult to realise how it is that the whole country is not covered

BLACK BRYONY CLIMBING UP BRACKEN.

with these trees. A considerable number of the seeds, it is true, are destroyed by the wild animals and birds of the forest, but after all only a small number are accounted for in this way. Probably the majority of the seeds germinate, and even grow into little plants during the first few weeks of mild spring weather, before the forest is clad with its summer foliage. But it is only a very few which get beyond the start, for under the dense shade thrown by the clustering leaves above no development is possible; and more often than not it is the spreading branches of the parent tree which bring about the destruction of the latter's own offspring.

THE BRAMBLE IS ALWAYS ABLE TO CHANGE ITS SHOOTS INTO ROOTS SHOULD A FAVOURABLE POSITION PRESENT ITSELF.

Many plants which flower in the late spring might easily be smothered out of existence, had they not been enabled to make special provision against such a contingency. With the arrival of the really warm weather the countless seeds which have been lying dormant all the winter start to germinate. In this connection a curious phase in the life of the Primrose is the habit of "flopping" its foliage after blooming time. As one of the earliest of our spring flowering species, the Primrose has a good start over the rank-growing weeds which will not put in an appearance until the early summer. But as the last of the pale yellow flowers dies, the plant enters a critical period of its life; it is in grave danger of being smothered out of existence. At this time, however, a very marked change comes over the bearing of the foliage; the leaves lose their more or less erect habit and "flop" over on to the ground, encircling the crown of the plant. In this way, the menacing army of seedlings which will come with the end of May are prevented from making any headway in close proximity to the plant. If it were not for this provision there can be little doubt that the Primrose would be almost choked by the rank-growing weeds which are on every side. Many of the late spring blooming varieties of the smaller Hyacinths send out a profusion of drooping leaves just at flowering time. These will make it quite certain that the plants will not be troubled by any near neighbour.

In the case of a large number of common weeds the habit of growth, which has been referred to as "starring," is a very pronounced feature. As is well known, the matter of leaf arrangement in the plant

has been devised on definite lines, and with a mathematical precision. Each leaf has its exact place, and when development is unhindered by any restraining influence the exactitude of the system becomes very apparent. In a well-developed Dandelion, where the growth is quite free, a most perfect rosette is often formed, each leaf falling into its place with a wonderful regularity. The little Shepherd's Purse, a very common cruciferous weed, which sends its clusters of dainty white blossoms up to a considerable height, employs the greater part of its foliage in covering the ground in its immediate vicinity. Examples of this plant will easily spread over a rough circle of land which is as much as nine or twelve inches in diameter. Through the dense, matted growth of leaves formed by these plants, there is little chance that any smaller species could hope to make headway.

The Dwarf Plume Thistle, a plant commonly found in meadows near the coast in the south of England, has proved itself to be a most pernicious weed from the farmer's point of view. The leaf arrangement round the central stem which bears the short-stalked flower, really forms a most attractive pattern, and one which shows plainly by what a rigid code of rules the plant is designed. From the agriculturist's outlook, however, the Dwarf Plume Thistle is anything but a welcome addition to the pasture land.

As a strong-growing perennial, when once the plant has secured a hold, its method of "starring" is very prejudicial to the growth of tender grasses and small herbs. None of these less robust plants can possibly make any headway beneath the clinging leaves of the thistle.

S. Leonard Bastin.

THE PRIMROSE IS IN THE HABIT OF "FLOPPING" ITS FOLIAGE AFTER BLOOMING TIME.

HOW BIRDS MAKE LOVE

Some romantic episodes in the life of a Bird

By OXLEY GRABHAM, M.A.

DURING the month of February a few early breeders amongst birds, such as the Heron and the Raven, will be taking their yearly load of domestic duties upon their shoulders. And first let me say that some birds are very matter-of-fact about it. The sexes sometimes pair off with each other with little or none of what may be called the preliminaries of love-making; whilst others, chiefly in the case of the male bird, go through all sorts of extraordinary antics, many of them decidedly grotesque, to attract the attention of the female. A third section apparently follow out the old plan prevalent among our noble selves, in olden days, of marriage by capture—and certain birds having fought a series of duels amongst themselves for the object of their affections, the conqueror quietly takes possession of his mate, whilst his defeated rivals have to sue elsewhere, and in all probability have to go through the same sort of battles over again, until in time they are all provided with a spouse.

Like the human race, again, some birds are polygamous, having many wives; whilst others are strictly limited to one, and remain perfectly faithful to her. Some species are generally believed to pair for life—and I believe that this is true. Others make a contract that lasts for one season, and after that they appear to consider themselves perfectly free to choose elsewhere; whilst others, again, either pair for two or three seasons, or else choose a fresh mate each returning spring.

It is a very curious thing that whereas amongst the *genus homo* it is the lady that is most brilliantly arrayed, enhancing her charms with jewels and raiment of many hues, amongst birds it is almost invariably the case that the female is very plainly and soberly attired, whilst the male is often a magnificent creature, radiant with all the colours of the rainbow, and putting on for a season crests, tufts of peculiar feathers, and various other appendages, which vanish when the breeding season is over. There are exceptions to the rule that the male is the most handsomely plumaged amongst the birds of our own country—such as the Dotterel, one of the most beautiful of the Plover kind, which unfortunately is rapidly approaching extinction in Great Britain. In nearly every other instance, however, it is the male bird who is by far the handsomer; and of course a very good reason can be given for this most wise provision of Nature: namely, that it is, as a rule, the hen bird which does most of the sitting upon and hatching out the eggs, at which most important period for the life of the future family her sober, dull-coloured plumage harmonises so beautifully with her surroundings that, save to a practised eye, she is most difficult to detect.

Were the male bird to take upon himself these duties entirely—he often assists in a most praiseworthy fashion—there would be far more chance of his being discovered by marauding enemies—whether possessing two or four legs—and of being destroyed himself, along with the eggs he was incubating.

Many birds are most polite and assiduous in their attentions to their mates. A very well known instance of this may be seen any day in our farmyards—for it will there be noticed, when the poultry is fed, that the male bird will often never attempt to pick up any of the corn or dainty morsels thrown about him until he has called his hens round

him and they have satisfied themselves. Again, he will frequently, by scratching away the earth with his feet, pick out certain portions that are apt to be overlooked, and place them before the favoured members of his harem.

The antics and evolutions which are gone through by some birds in order to show themselves off, as they evidently imagine, to their fullest advantage, and to attract the notice of their consorts, observing them, that I may be pardoned if I quote his description: "The cock bird stations himself on a pine tree and commences his love song to attract the hens about him. This is usually from the first dawn of day to sunrise, or from a little after sunset until it is quite dark. The time, however, more or less depends upon the mildness of the weather and the advanced state of the season. During his play, the neck of the Capercailzie is

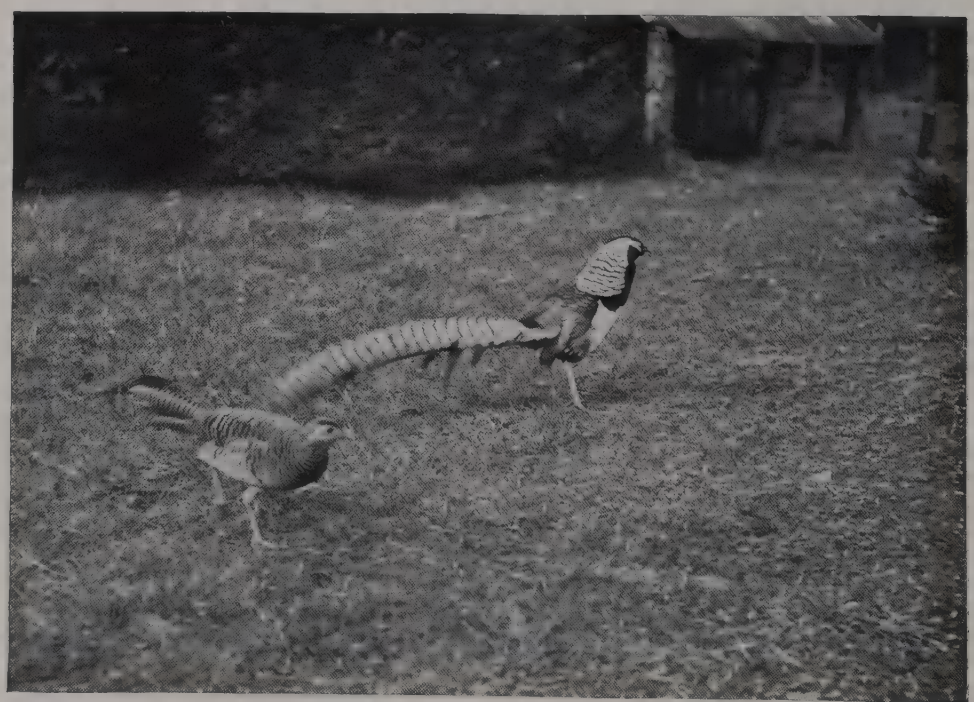
THE GREAT WHITE HERON SHOWING BREEDING PLUMES.

are very amusing to watch, and are often ludicrous in the extreme. The behaviour of pigeons in this respect will be familiar to everyone. They strut about in the most absurd manner before and around the object of their affections, continually bowing down to the ground and then stretching themselves to their full height, spreading out their wings and trailing them on the ground, expanding their tails, puffing out their breasts and throats, and showing off their plumage in the bright sunshine to the best effect possible. The actions of the Capercailzie, the largest of our game birds, during the spring of the year, often when the ground is still deeply covered with snow, are well known to naturalists and sportsmen, and have been so well described by Mr. Lloyd, who spent many years in Sweden, and had ample opportunities of stretched out, his tail is raised and spread out like a fan, his wings droop, his feathers are ruffled up, and in short he resembles very much in appearance an angry turkey-cock. He begins his play with a call something resembling the word *peller-peller-peller;* these sounds he repeats, at first at some little intervals; but as he proceeds they increase in rapidity, until at last, and after a lapse of a minute or so, he makes a sort of gulp in his throat, and finishes by drawing in his breath. During the continuance of this latter process, which only lasts a few seconds, the head of the Capercailzie is thrown up, his eyes are partially closed, and his whole appearance would denote that he is worked up into an agony of passion. On hearing the call of the cock, the hens, whose cry in some degree resembles the croak of the Raven, assemble from all

parts of the surrounding forest. The male bird then descends from the eminence on which he was perched, to the ground, where he and his female friends join company. He does not, however, play indiscriminately over the forest, but he has his certain stations, which may be called his playing grounds. These are often of considerable extent. He does not during his play confine himself to any particular tree, and is seldom to be met with exactly on the same spot for two days in succession. On these playing grounds several Capercailzie may occasionally be heard playing at the same time. Old male birds will not permit the young ones or those of the preceding year to play. Combats, as may be supposed, not unfrequently take place on these occasions."

The Blackcock, a far more common bird in these islands than the Capercailzie, is polygamous, and has his pairing grounds, which are visited somewhat early in the season, and the *lek*, as it is called, has often been described. The males assemble even before the first dawn of day and utter a series of notes which can be heard a considerable distance off. When the old cocks alight they begin to make love to the hens, who keep somewhat in the background amongst the bushes. They strut about with outstretched neck, trailing wings, and expanded tail, occasionally vaulting high in the air, and describing an irregular somersault, coming down with the head turned in the opposite direction. Desperate combats frequently ensue, and at times even a general mêlée. When the *lek* is over for the time the birds separate, each husband accompanied by the wives which he has secured.

The male Great Bustard in the breeding season throws himself into the most extraordinary attitudes, drawing in his neck, puffing out his body, expanding his tail and the pouch in his throat. He, moreover, throws his wings into the most curious positions, making them appear as if they were turned round, as it were; and upon looking at the bird when in this mood I have often been really puzzled to say exactly where the wings join the body, and where they end.



LADY AMHERST COCK PLAYING TO HEN.

To come to a more familiar bird, namely, the Snipe, everyone with the least taste for the study of birds and country sights and sounds must be familiar with what is universally known as the " drumming " of the Snipe during the breeding season. This peculiar noise made by the bird was for a long time considered to be produced by the mouth, but it has now been definitely proved that the bird, soaring to a considerable height, and then dropping suddenly with great velocity, with a tremulous movement of its wings, accompanied by the outspreading of the stiff tail feathers, produces the peculiar sound which is variously known as " drumming " or " bleating." This performance on the part of the bird is considered to be largely to attract the notice of the female, and as a kind of show-off before her. This " drumming " is continued also during the whole of the time that the female is sitting on the eggs.

Another instance may be taken in the case of the Ruff, a bird which at one time bred commonly in the Fens and other suitable localities throughout the country, but which now, save in very exceptional cases, may be considered as only a passing visitor to this country. The males have a regular thick ruff on the neck and sides of the head during the breeding season, which they can erect and frill out at will. From this singular appendage the bird takes its name. The males contend for the females as in the case of other polygamous birds, and in the spring they " hill," as it is called; that is, they gather together on a bit of rising ground close to where the Reeves, as the females are called, propose to deposit their eggs. There they take their stand at a small distance from each other and contend for the females, their actions in fighting being very similar to those of a game-cock. The head is lowered and the beak held in a horizontal direction; the ruff, and indeed every feather, more or less distended, the former sweeping the ground as a shield to defend the more tender parts; the auricles are erected, the tail is partly spread, and upon the whole the birds assume a most ferocious aspect. As in the case of many other birds that go through these duels in front of their future mates, they frequently catch hold of each other by the bill, and although they strike with their wings and legs, they seldom do one another much harm.

PHEASANTS VERSED IN THE ARTS OF COQUETRY.

In the case of the smaller birds, such as the Warblers, Finches, etc., which are not polygamous but pair for one season, at any rate, and in some instances for longer, the same kind of performance is gone through.

OXLEY GRABHAM.

THE KINSHIP OF PLANTS TO ANIMALS—II

By WALTER P. WRIGHT

Illustrated with Photographs by E. J. WALLIS

IN a former article I referred to some remarkable examples of the association between plants and insects. Cross fertilisation is not facilitated by form of flower alone. Some flowers have earned an unenviable reputation on account of their evil odour. The common "Lords and Ladies" of the hedgerows (*Arum maculatum*) is one, but for the credit of the country it is satisfactory to be able to say that its smell is ambrosial compared with that of certain exotic members of the same family, notably the genus *Amorphophallus*. Perhaps the harassed reader will declare that the odour of this plant cannot be worse than its name. Possibly the effluvium disseminated by the flower attracts carrion flies and other insects that love odours generally associated with putrefaction, and which assist pollination. Certainly Nature does employ scents to attract insects, and, fortunately for us, she makes an appeal to those which like pleasant perfumes as well as to those which enjoy smells disagreeable to human noses. She caters for night insects too; note the scented white tobacco flower, and the stock. Some flowers play scurvy tricks on the insects which visit them in search of nectar, brewing so strong a liquid that it causes intoxication. Alas! observers have noted that, when an insect has recovered, it has hastened eagerly back for more, like a confirmed tippler. Lime flowers have been known to cause intoxication in innocent humble-bees, and the flowers of ivy and opium poppy have had a too potent effect on flies and other insects.

What are known as insectivorous plants have long been objects of interest. One of the most remarkable of these is certainly the "Pitcher plant" (*Nepenthes*), a large variety of which is shown in an earlier photograph. The leaf of this plant has an extraordinary appendage, taking the form of an urn, which is sus-

ECHEVERIA METALLICA MONSTROSA.

pended from the leaf by a slender stalk. The urn is partly filled with water. Insects climb over the edge, crawl down to sip, and find that they cannot get back again, because the way is barred by a row of stiff hairs which point downwards. They are drowned eventually, and provide nutriment for the plant. The urns vary in size with the variety. In some instances it is capable of holding a couple of quarts.

The *Sarracenia* is another insectivorous plant, the leaves of which resemble long tubes with open lids; the tubes act in the same way as the pitchers of the *Nepenthes*. The "Sundews" (*Droseras*) catch their prey in a different manner. The leaves are covered with a sticky substance, which captures and dissolves the insects. The "Venus's Fly-trap" (*Dionæa muscipula*) has a device for catching insects that can only be described as extraordinary. The leaves terminate in a trap, like an ordinary gin, rabbit, or rat trap. When the unsuspecting insect alights on the inside of the trap and touches the sensitive hairs the trap is sprung, and it does not open again until the insect is dead.

The curious forms that leaves sometimes take are illustrated by the photograph of *Echeveria metallica monstrosa*. A cancer-like growth appears on the surface of each leaf. It is difficult to decide what is the cause of this strange development.

The *Mesembryanthemums* (see photograph) also have remarkable leaves, which are of the thick, fleshy character peculiar to plants which are natives of hot, dry countries. Two species, called respectively *simulans* and *Bolusii*, have leaves as thick as they are broad. The leaves of other *Mesembryanthemums* are almost exactly like small pebbles.

The "Sensitive plant" (*Mimosa pudica*) has finely cut foliage which is so sensitive that it closes at the slightest touch.

In countries subjected to very heavy rains the leaves of many plants terminate in a long, narrow point, the object of which, scientists tell us, is to serve as a drain, the water always running off at the point. The gum trees of Australia (*Eucalypti*) are frequently subjected to severe storms, and consequently they have narrow leaves arranged with the edges towards the trees so that they do not catch the wind, and the minimum amount of injury is inflicted. The wattles (*Acacias*) of Australia are curious by reason of the fact that they have flattened branches coloured and formed like leaves instead of true leaves.

Australia has given us many peculiar plants besides these. One is the "Glory Pea" (*Clianthus dampieri*), a weird and uncanny looking flower, shaped almost like a torpedo, fiery red in colour, with a black blotch, like a huge menacing eye, on a prominent boss in the centre. One may see it sometimes growing in a basket suspended from the roof of one of the glass houses in Kew Gardens. Seen just before closing time on an autumn afternoon, when the gloaming is falling, its effect is almost blood-curdling, especially if it be encountered suddenly.

The "Bottle-brushes" (*Callistemons*) are not so awe-inspiring, but are even more singular. The red flowers are arranged round the branches in exactly the form of a bottle brush. The "Flannel flower" (*Actinotus helianthi*), which also comes from the land of the wallabies, has blossoms suggestive of a piece of flannel. They bear a resemblance to the well known Swiss mountain plant edelweiss.

There is a tropical relative of the kidney bean which is called the "Snail flower" (*Phaseolus caracalla*), on account of the curious curled-up flowers resembling a snail with its house on its back.

Some flowers only commence to open when the sun sets, and fade about the time that the sun rises the following morning. Various sorts of Cacti (*Cereus*) have this peculiarity. They are dry, insignificant-looking plants during the day, which the majority of people would pass by with nothing more than a casual glance. But during the night, when in bloom, they are glorious. The flowers may be nine or ten inches across, with white, cream, or pale yellow petals flushed with red, and large tassel-like bunches of stamens. They exhale a delicious perfume.

Some flowers which are minute and insignificant in themselves have adopted an ingenious device for arresting attention, and that is to surround themselves with brightly coloured bracts or spathes. Perhaps the most remarkable example

of this is *Poinsettia pulcherrima*. The flower is absolutely commonplace, but the leaf-like bract, which is often spoken of as the flower, is large and coloured vivid scarlet. Few true flowers are so brilliant as this pseudo-blossom. The common Arum lily (*calla* or *richardia*) is a familiar example of the peculiarity now under consideration. The flower is small, but the spathe is large and pure white. The latter serves the purpose of a flower admirably, and as the plant is "in bloom" during the winter and spring it is found extremely useful by gardeners, and by those who decorate rooms and churches.

The warm house plant called the "Flamingo flower" (*Anthurium*) has large orange or scarlet spathes, and the greenhouse wall plant *Bougainvillea glabra* has bracts of a lovely satiny mauve hue which are produced in such dense masses as to hide the leaves.

One other example may be given, and that is "the largest flower in the world" —*Amorphophallus titanum*. The true flowers are arranged on a spadix five feet high. The spathe is from three to four feet across. Only one leaf is produced, and that may be twelve feet high and fifteen feet across.

Nature, then, has many plant wonders, but her "Century plant," which blooms regularly every hundred years, is a myth. The reference is to *Agave americana*, but the truth about it is that it dies after flowering. Its peculiarity of only blooming once is shared by some of the hardy bamboos. There has been quite an epidemic among these plants of recent years, which have been dying off in various parts of the country, but it is not a case of disease. The plants have arrived at their flowering stage, and their life work is ended.

WALTER P. WRIGHT.

MESEMBRYANTHEMUM TRUNCATELLUM.

THE ROSE GARDEN, HATFIELD HOUSE.

From the Water-Colour Drawing by E. A. Rowe.

YOUNG HOUSE MARTINS.

NESTLINGS

By J. WILLIAMSON

Illustrated from Open-air Photographs by the Author

OFTTIMES during the long winter evenings have I taken up my photographs of bird life and gone over the old excursions. These are pictures of which one never tires, they are redolent of white and sparkling sunshine and growing woods and singing birds.

The empty woods in winter make the heart heavy with the thought of past joys, and one is inclined to make odious comparisons. I think of a deserted ballroom, now dark and cold and empty, where once fair women and lights and sparkle of conversation illumined the scene. The trees in the wood are bare and uninviting, there is no luscious thicknesses of undergrowth with mosaic of colouring, no scented and warm air nor the musical sounds of yore, and—most unkindest cut of all—no merry voices of bird and bee nor sound of growing things. The glorious pulsating heart is verily asleep. But now it awakes and the singing of birds is come. They are singing love songs to their mates, and after a while there is ushered into the world the sweetest thing in Nature—nestlings, downy little dears that appeal instinctively to the human heart. When a woman discovers a nest full of young birds she just wants to hug the lot. A man photographs them.

Have you ever tried to hold a young bird in your hand? It is a real delight to feel their little plump bodies encased as they are in fluff and feather.

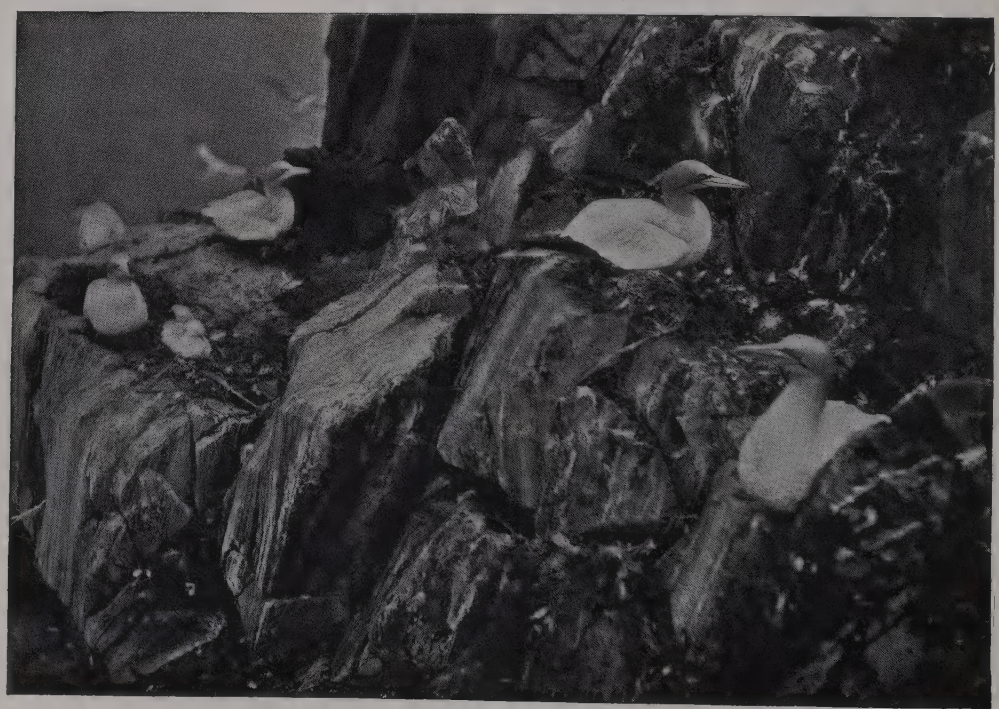
Never attempt to take an unfeathered youngster out of its nest; you are sure to hurt it, they are nervous and delicate little creatures. Even when feathered, it

is well to leave them alone, as they are very apt to forsake the nest when removed. The restless spirit of the world seizes them, and in seeking pastures new they might possibly die of starvation or fall a victim to other enemies. There are exceptions to this rule, however. I know that fledgelings that are ready to run on issuing from the egg will gather and regather to the nest on the call that must be obeyed—the parental call.

Nature guards the young ground birds, as for example the Lark and Duck and Game birds, by giving them coloration in mimicry of their surroundings. It would be quite a simple thing to trample on a Lark's nest full of young, or a young and crouching Plover, without noticing them. In the town we have posts warning us to keep to the right, and in the country we will walk in the right if we watch every step we take. There is a marvellous world at our feet in the country places if we only look hard enough. The countryside has no more charming picture than that which may often be seen of a row of young Long-tailed Tits being fed by their parents. Once in the vicinity of Loch Lomond I observed the young being fed. As a rule, only one at a time alighted to feed the youngsters. One little chap was inclined to be sleepy, but I noticed the parent bird would not allow him to miss his meal, even when clamouring brothers and sisters with argument of wide open mouth more insistently appealed.

As a rule, nestlings are fed according to their importunity. If they don't open their mouths they get nothing. Thus the survival of the strongest prevails. There are no hospitals or cripple homes for infirm nestlings in birdland.

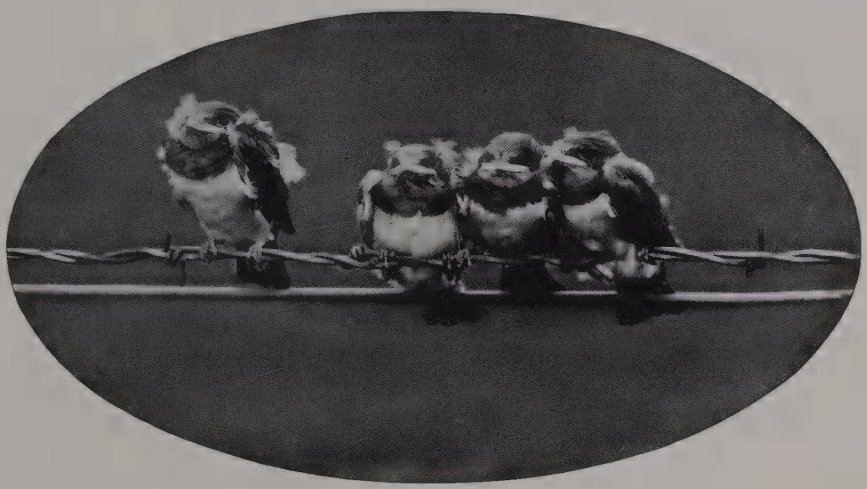
The nest of the Long-tailed Tit is a very handsome structure. Lovers of birds, and happily their name is legion, give this nest pride of place as the most perfect specimen of bird architecture in this country. Elongated in shape, composed of moss and lichen, and wonderfully felted together with spider webs and lined with feathers, it is indeed a fairy home.



SOLAN GEESE.

Over two thousand feathers have been found inside this little palace.

It is a real joy of country life to see such a family of Tits following their parents, in their curious way, hide and seek or "follow the leader" fashion through the hedgerows and fields and leafy woods. They keep together in this merry march, uttering a quaint little monosyllable, until the spring, when the joys of pairing break up the happy family circle.



YOUNG SWALLOWS DISCUSSING THE WEATHER.

We have all at some time, I hope, made the joyful discovery of a nest of young Thrushes. The photograph (p. 855) shows them inquisitively watching the photographer and camera, and no doubt wondering if this is a new feeding machine. While taking this photo the old birds, as is their wont, were screaming around, much concerned about the fate of their babies.

Scotland has not been honoured with the Nightingale, and has to wax eloquent over the singing capacity of her Thrushes, which have been well called the "Scottish nightingales." The lovely mottled breast of these handsome birds, which is conspicuous for its beauty, is seen in the young in the photograph. When very young warm nest birds do not require so much down, and are born practically naked. The principle in Nature seems to be that chicks which are born on the ground, or require to battle for life at an early stage, are early well protected with feather or down, while birds reared in an enclosed and comfortable nest have their down coats in all stages of degeneracy.

Notice how like a powder-puff is the fluffy youngster of a Solan Goose or Gannet. His blanket coat is of the most pleasing white down. A white spot on the tip of the upper mandible shows the weapon by which he hammers his way to the outside world from the inside of the egg. When younger he was an ugly, little, black, sprawling rascal as bare on the skin as the back of your hand, and by sound and appearance not unlike a little puppy dog. To be down among them on the cliffs of the Bass Rock or Ailsa Craig is an experience unforgettable. The photograph of the Solans sitting on their nests (p. 850) gives you an idea of the boldness of these magnificent birds. I could have touched them while taking the picture. The parent Solan or Gannet, by means of his gular pouch, is able to deposit a fairly large quantity of food when feeding his family of one. On this food, composed of herring fry, about three inches of length, the youngster gorges himself. You will find balls about one and a half inches in diameter on the edges of many of the nests. These have been regurgitated by the parent birds, and constitute a granary for their young.

The number of Gannets which annually visit the Bass Rock is estimated at from sixteen to twenty thousand, and they are regarded as pests by fishermen on account of the enormous quantity of herring fry they consume.

The two photographs of young Blackbirds show different stages of development though not the same birds. The blackamoors on the tree are more at ease than thus no necessity for them to turn round, which is a very handy acquirement in confined apartments.

The ways of the Starling are sometimes curious in her efforts to feed her young. Once while photographing this bird I noticed that it did not know its nest hole "right off." There were two nests in one part of a bridge, and a Starling would often alight at one hole

WILD CHAFFINCH FEEDING YOUNG.

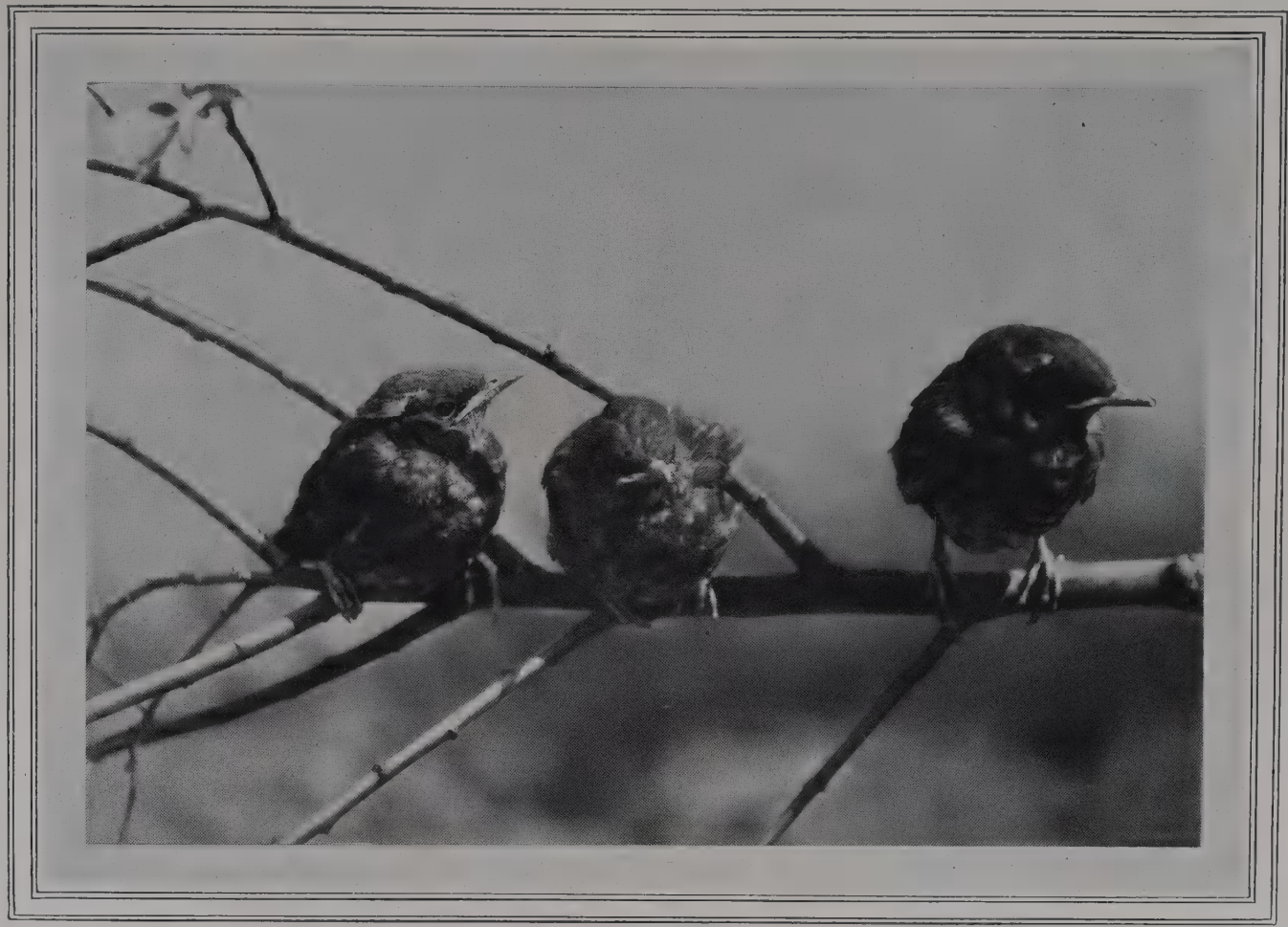
the tribal members in the nest. This sable-coated songster is as well known as the Thrush, and almost as much admired. His song appears to be a more cut-and-dried production than that of the Thrush. The Thrush is an *inspired* musician. The Blackbird would appear to be always going over his musical lesson, and I think he learns it exceedingly well. The mellow liquid notes are very refreshing; and when this sweet singer is perched on the "highest turret" of spruce or fir, his notes gather a new meaning and give satisfying enjoyment.

Where young birds are brought up in holes Nature adapts them to their surroundings. For example, Woodpeckers have little excrescences on their back joints, and they go back and forward in their confined homes with a shuffling gait which is remarkably swift. There is first by mistake and then go over to the other, which it entered.

Starlings have often been suspected of polygamy; but if you get a nest containing more than six eggs—the number they generally lay—you must not judge too hastily. It is quite possible that in some cases, at least, the first female may have died and the widower taken to himself another wife.

Young Swallows and House Martins appeal to us chiefly because of the marvellous rapidity of even their early flights. Occasionally you may come across a young Swallow or House Martin too weak to fly. In such a case carefully and tenderly examine the bird and you will most likely find spidery-looking insects under its wing.

When I first saw these parasites I did not like to touch them, but one must



YOUNG BLACKBIRDS' FIRST OUTLOOK ON THE LARGER WORLD.

YOUNG BLACKBIRDS IN NEST.

overcome such feelings and carefully pick these degraded flies off the birds. The flies are quite noticeable, having sickle-shaped wings, which are of no use for flight. These flies being strong, and the bird's beak being weak, it is impossible for the poor creature to get rid of them, and so the chick weakens and dies. It is among the later brood of Swallows and Martins you will generally find this parasite; the reason is obvious, the flies having been gradually multiplying during the summer.

Even the best of things are puzzling at times. To the average man it is too much of a puzzle to distinguish the House Martin from the Swallow. He gets out of the difficulty by calling them both Swallows. The photographs on pages 849 and 851 will help him.

The Swallow, or "Chimney Swallow," is clearly distinguished from the House Martin by the dark chestnut colour of the throat.

One of the greatest miracles in Nature is the migration of birds, and when we remember that the Swallow tribe winter even as far away as South Africa, we can only marvel and admire. Over these thousands of miles of sea and land will a Swallow come back in the spring, wafted by the soft south winds, to its little nest perhaps in a byre, in a shepherd's shieling hidden away in the Scottish hills.

Just before going for "winter" holidays Swallows gather, as a rule, near water, and it is this strange habit that has most likely given rise to the stupid notion that they hibernate in the mud or soft ground beneath the water. Gilbert White in his classical pages discusses this idea, and, of course, refutes the possibility of such a thing.

One of the commonest, prettiest and boldest of our British birds is the Chaffinch.

WILD CHAFFINCHES ON A CRAB-APPLE TREE.

YOUNG THRUSHES IN NEST.

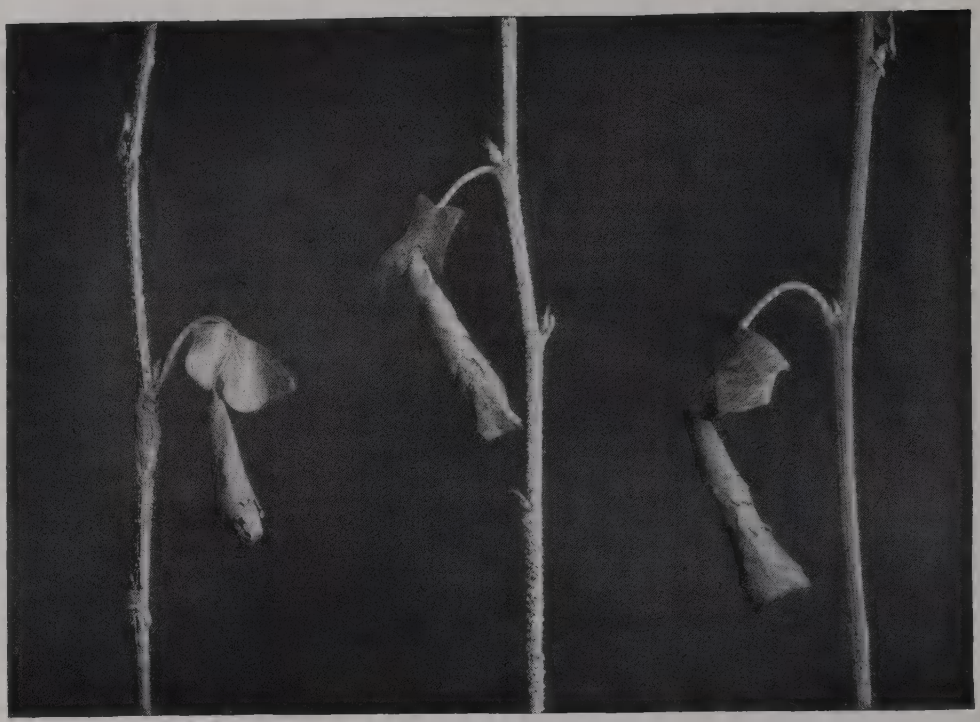
Its cheery "pink pink" resounds along the country road from hedge and tree.

With blue cap and black, white and saffron on wings and breast, it is a conspicuous and delightful little bundle of activity, and has endeared itself to us all. The nest is a compact little structure, felted together with moss and lichen and cosily lined with hair and feathers. This nest may be frequently found in a hawthorn hedge.

The protective coloration of the outside of the nest corresponds so exactly at times to the lichen, etc., on the tree on which it is built that you might be looking at it and yet not see it. On the other hand, I have found the outside of the nest interspersed with small pieces of paper—sometimes relics of the paper chase — which give the nest an ornamental rather than a protective appearance.

If you wish to come closely in touch with Nature, buy a camera and begin photographing her. A photograph of a living bird is better than a dozen stuffed birds in a glass case. To photograph that bird feeding its young is one of the most exciting and wholesome things in life. It is pleasure without pain.

DUCKS ON POND.



LEAVES ROLLED BY LEAF-ROLLING WEEVIL.

THE BIRCH LEAF-ROLLING WEEVIL

By HAROLD BASTIN

Illustrated from Photographs by the Author

IN the whole realm of Nature I know of nothing more astonishing than the behaviour of certain small beetles of the Weevil class which are grouped by naturalists in the families *Rhynchitidæ* and *Attelabidæ*. These insects are known popularly as "Leaf-rollers," because the females, during the period of egg-laying, prepare leaves in an elaborate manner to serve as food and dwelling-places for their young. Both families are represented in the North American continent; but in Europe the species are much more numerous, while one (*Rhynchites bacchus*) has gained notoriety as a "pest." It mutilates vine leaves in such numbers as seriously to affect the growth of the plant. But it is with an allied British species that I propose briefly to deal. It is known to science as *Rhynchites betulæ*. This high-sounding name, being freely translated, signifies "the nosey one of the birch tree," and is singularly appropriate, for it indicates at once the beetle's prominent feature—*i.e.* its snout or rostrum —and its place of residence. Young birch trees, from five to ten feet high, growing at the outskirts of plantations, should be searched during the summer months by those who desire the acquaintance of the "nosey one."

Probably the searcher will first find

only the Weevil's work. Some of the birch leaves are cut and rolled up in the form of little "screws," such as a grocer makes of the papers which are destined to hold pounds of moist sugar. A photograph showing three of these leaves is reproduced on page 856, and when such leaves are detected upon a birch tree, the Weevil herself is not likely to be far off. On seeing her for the first time the reader will, perhaps, find it difficult to believe that she can be in any way connected with the tightly rolled leaves. She is so insignificant—barely a quarter of an inch in length! Yet cut and roll the leaves she certainly does, as the reader may ascertain for himself if he be disposed to watch the somewhat slow progress of her labours.

Let us suppose that we have been lucky enough to discover a Weevil about to operate upon a birch leaf, and that we have leisure at our disposal to witness the completion of the work. The whole process may take as long as two hours, and it is seldom finished in less than an hour and a half; so that the watcher must be prepared to draw upon his stock of patience.

I should like, at this juncture, to emphasise the fact that it is the *female* Weevil alone who engages in the arduous task of leaf-rolling. He who in name is her lord and master is a mere looker-on—a pitiful nonentity striving to bolster up authority by means of futile officiousness and senseless meddling. I have seen him stand close to his mate while she is engaged in her toil, seeming to criticise, or perhaps to offer contemptuous words of advice. I have also seen him turn to flee when the tide of labour sets in his direction. Not that "my lady of the birch" is actually aggressive. She simply sweeps her slothful partner from the leaf by the sheer force of ceaseless activity.

To return, however, to the Weevil which is about to commence rolling. First, she does a deal of prospecting, moving deliberately about, both upon the upper and the lower surfaces of the leaf. We realise that the choice of a leaf is a matter of no small importance. At length, satisfied with her investigations, the insect makes her way to a point at the edge of the leaf, not far from the stalk, and, standing upon the upper surface, makes a long, curving cut with her tiny jaws from the edge to the midrib. She then ascends the leaf for a short distance, and from the other side of the midrib makes another curving cut to the opposite edge. A beetle who has just completed her cutting is shown in the photograph on page 859.

UPPER SIDE OF LEAF: THE BEETLE HAS JUST COMPLETED ITS CUTS.

In favourable circumstances this preliminary labour is accomplished in from ten to fifteen minutes. It is a fact worthy of note that the beetle works without the slightest hesitation, cutting the leaf-tissue readily and continuously. Yet the curved incisions, each of which resemble roughly the letter S, have been examined by mathematicians, who have (to quote Dr. David Sharp) "extolled them as being conducted on highly satisfactory mathematical principles." In a word, these curves are precisely those which are necessary to render the subsequent rolling of the leaf most easy of

accomplishment. Should the insect fail to project accurately these curves, she will fail also in her attempts to roll up the leaf. Indeed, I think that the Weevil's instinct is by no means infallible in this matter, and that faulty curves account for the many half-rolled and deserted leaves which one may find upon the birch twigs where the insects are at work.

But in the particular case which, in imagination, we have under observation, we will suppose that our Weevil's curves have been accurately projected. When she has finished the cuts, she takes a long rest—not, I believe, because she is fatigued, but in order that the pendent portion of the leaf may become more flexible. The uncut leaf is stiff with the pressure of the sap. But as soon as the cuts are made the vegetable tissue begins to wither, and becomes gradually quite flabby. We see, therefore, that the insect's long pause at this juncture is all to her advantage—may, indeed, be regarded as part of her scheme. When, however, the leaf has become sufficiently pliable, the Weevil goes to its under surface, and standing close to the edge where her original cut begins, commences to roll one side of the leaf round an ideal axis by means of her legs. When watching her I have been irresistibly reminded of a man "on all fours" rolling up an immense sheet of linoleum.

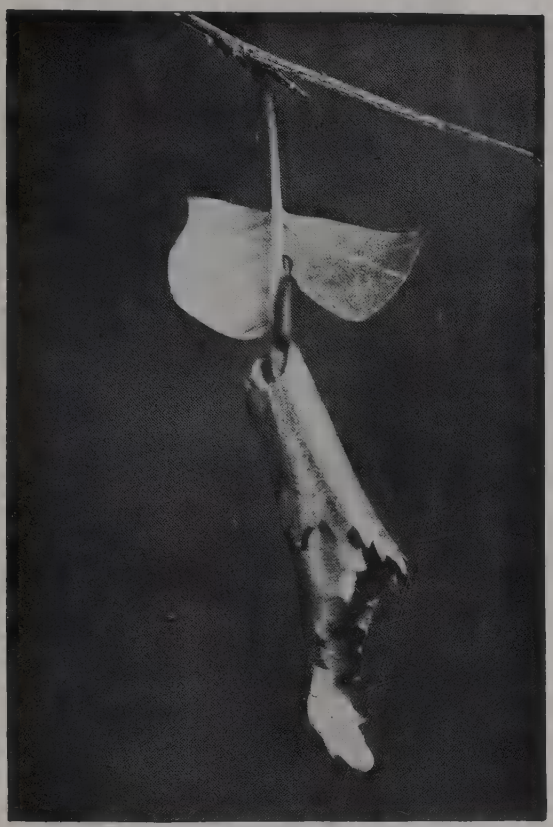
THE ROLLING HALF DONE.

As one observes the progress of the work, one realises how greatly the Weevil is helped by the curved incisions which she first made. These prove to be exactly what is needed to counteract any tendency to spring back on the part of the rolled-up leaf.

When the Weevil has rolled one side of the leaf to the midrib, she alters her tactics somewhat. Holding by the legs on one side of her body to the rolled-up part of the leaf, she drags at the unrolled portion beyond the midrib with her other legs. In this way she slowly draws the second part of the leaf round the part which she has already rolled, incidentally wrapping herself within the folds. When the stage shown in the photograph on page 859 is reached, she makes several incisions in the leaf-tissue and lays an egg in each. Thereafter she comes forth, tightens the roll, and fastens down the overlap by means of her jaws. The tip of the leaf now claims her attention. Of it she makes a second and smaller funnel, and bends this inwards so as to close the end of the first funnel.

Finally, the Weevil ascends the rolled leaf, and partly cuts through the midrib at the point where her first curved cut meets it. She appears to do this with a view to promoting that particular state of decay in the leaf which will render it fit food for the grubs.

If we trace the life cycle of *Rhynchites betulæ* we shall only find additional cause to wonder at the behaviour of the adult insect. The eggs, which hatch in the rolled-up leaf, produce blind and legless maggots. These feed upon the leaf-tissue around them, and when full grown make their way out of the roll and drop to the ground, where, beneath the soil, they change to pupæ. In this state they pass through the winter, and in the early summer the adult beetle comes forth and



THE ROLLING ALMOST COMPLETE. AT THIS STAGE THE BEETLE LAYS ITS EGGS WITHIN THE LEAF.

creeps up the birch stems. From these facts the reader will perceive that the newly emerged Weevil cannot, by any conceivable chance, have seen a rolled birch leaf. Thus, it is plain that imitation plays no part in the subsequent procedure of the insect. The elaborate cutting and rolling in which the Weevil engages can be explained only by employing the word "instinct," and this, as the reader will be well aware, is really no explanation at all.

The Birch Leaf-rolling Weevil is by no means the only English beetle which rolls up leaves. Nor does it confine its activities to birch trees. It may often be found hard at work upon alder bushes. Moreover, there are two species of the family *Attelabidæ*—both of them beautiful, coral-red insects considerably larger than *Rhynchites betulæ*—which roll up oak leaves and hazel leaves, each species accomplishing its work in a different and characteristic manner. These two beetles may be described as "locally common"—*i.e.* they are not always to be found when wanted, but when found they will be present in numbers. The writer has often observed the manner in which *Attelabus curculionides* rolls up its oak leaves, but considerations of space prevent a detailed description of its methods being added. Suffice it to say, that the insect proves itself equal in ingenuity to its relative of the birch tree, and that its rolled-up leaf, when finished, resembles a small thimble, or barrel, rather than a screw.

Exactly why these Weevils adopt the plan of leaf-rolling as a means of providing food and shelter for their grubs is not definitely known. Quite a number of species, which actually belong to the same genera, do not roll leaves at all. For example, a species of *Rhynchites* which is sometimes fairly abundant on hazel bushes, merely pierces the top shoots of that plant so as to arrest their growth, after having deposited an egg in each of them. Other species lay their eggs in the recently formed fruit of wild trees, afterwards duly making an incision in the stalk below, so that the fruit fails to develop properly, and ultimately falls to the ground, where it continues to provide nourishment for the grub within. It is thus perfectly clear that leaf-rolling is by no means essential to the well-being of these insects, and why some of the species should have acquired the habit is a problem which must be left unsolved pending the further advance of science.

BIRCH LEAF-ROLLING WEEVIL
(Magnified.)

CHAPTERS IN PLANT LIFE

II—THE PLANT AND THE SEASONS

By S. LEONARD BASTIN

Illustrated with Photographs by the Author

THE changes which come over the world of plants with the passage of the seasons are the most distinctive features of the countryside. At the approach of winter the greater number of trees and shrubs, in common with most perennial species, pass into a state of quiescence from which they will not emerge until the arrival of the spring. Such a course is only possible in conditions which involve a cessation of vegetable activity that is practically universal. In the tropical forests the trees are almost without exception evergreen in habit, and it is necessary that they should be so, if they are to hold their own in the fierce struggle for existence. The welfare of the tree depends upon the extent to which it can keep the soil beneath it in a state of dense shade. Underneath the spreading branches the ground is littered with germinating seeds, only waiting for a few rays of sunshine to enable them to start into a vigorous upgrowth. Should the tree become denuded of its foliage for even a short while, it would soon find itself surrounded by a host of formidable rivals that might threaten its very existence. No such considerations arise in the case of trees growing in temperate climes for at any rate half of the year. In the bitter days of winter there is no fear that the myriads of seeds which lie buried in the soil will start into life. Even should they do so during the first few weeks of warm weather they will scarce have grown into small plants before the branches above them are thick with rustling leaves.

To the lover of Nature every springtime comes with freshness, offering as it does a new opportunity to observe one of the most amazing sights in the whole world. The bare trees, the leafless hedges, and the brown earth are in a few short weeks transformed as by the touch of a magician's hand. So great is the up-rush of life that it is quite impossible to separate oneself from the joyousness of the resurrection. It is interesting to dwell upon the underlying causes which bring about this annual change. The question is one which must often arise—how do plants know the seasons ? At first sight it may seem that a renewal of activity is simply due to the fact that the cold weather is gone ; but this does not offer a complete solution of the problem.

Late last autumn the conditions were for weeks as uniformly mild as they are at present, yet the trees did not start into leaf. It may be suggested that it is the increase in the intensity and the amount of sunshine which arouses the plants from their winter slumber. This can hardly be the case with the large number of herbaceous plants with rootstocks inches below the surface of the soil, yet these respond to the call of spring no less readily than the deciduous trees and shrubs. Even more difficult to explain is the behaviour of the aquatic species, such as the Water Lilies. The roots of these plants are buried in mud many feet deep under water—how can they possibly be aware of the arrival of the new season ? Yet quite early in the spring these plants begin to stir into activity. Most strange of all in connection with the problem of the plant and the seasons is the story of the Soldanellas, small plants which exist on the lower slopes of the Alps. When the flower stems are in their most active state of growth they release a considerable amount of heat. In this way they will bore a course up through

a thick coating of ice and snow to the light and air above, when by some means, of which we can form little idea, the plant is aware that the spring has arrived. There seems to be something more in the phenomenon than can be explained as mere mechanical cause and effect. Indeed, the sympathy of the plant with the seasons is surely one of those mysteries which are as inscrutable as life itself.

The spring is perhaps the most trying time of the whole year for the plant. Often enough the first few fine days which have given promise of coming summer are followed by rigorous conditions which would more properly belong to the depths of winter. Yet it is very rarely that any serious damage results to the young foliage, even if the dainty leaves have already left the protection of the bud cases. To examine the expanding shoots of the Horse Chestnut, is to find that each leaf is clothed with a downy substance which forms a perfect protection against cold.

In the case of a large number of plants the foliage is not expanded until it is in an advanced stage; leaves rolled up or folded together are more likely to escape damage than those which are open. Another curious phase in the early development of the leaf is connected with the colouring of the tissue. Very young foliage is often of a reddish tint, a circumstance commonly to be seen in the case of Sycamore and Maple shoots. Crimson patches are also not infrequently seen on the upper surfaces of Hazel leaves. As well, the bud cases of many trees and shoots take on a bright crimson shade in the early part of the year. This is seen to great advantage in the case of the Lime trees. It is believed that this colouring is a protective measure, brought about to prevent an undue loss of heat. It has indeed been proved that the purple tinting on the under side of the Water Lily leaf is due to the presence of a curious pigment called anthocyanin, which has the remarkable property of changing light into heat. By this means the chilling influences of the water are controverted.

It is no hindrance to the enjoyment of

CHERRY LAURELS IN WINTER.

The drooping of the foliage during frost is valuable as a protective measure.

the spring day to consider the more immediate cause of the bursting buds and expanding leaves to be seen on every side. This is nothing less than the

WINTER.

resumption of the flow of sap—a process which has been almost entirely suspended during the last four or five months. All through the winter, growth on the part of the deciduous trees has been at a standstill, and only sufficient of the vitalising sap has been in circulation to keep the specimen from dying altogether. It must never be forgotten that when the tree is in its fullest state of activity, there are two very distinct currents of sap—the ascending and the descending flow. It is not an inapt illustration to compare the starting into growth of the tree to the lighting of a lamp. The developing leaves appear to exercise just that drawing power upon the liquid imbibed by the roots from the soil, which the burning wick does upon the oil in the reservoir.

The course which the sap pursues in a typical tree may be briefly outlined. Starting at the root, the fluid is carried upwards through the cells of the newer wood to the upper surface of the leaves. At this stage the sap is really little more than plain water, combined with certain inorganic matter taken from the soil. The force with which the sap rushes upwards is very great, and by way of experiment a vine stem was severed a few feet from the ground in the springtime, and a bladder tied over the cut end. In a short while the bladder was greatly extended, and finally burst, unable to sustain the tremendous pressure of the sap flow. It is not until the passage of the sap along the upper surface of the leaves that the great change comes in its composition. Exposed to the magical influence of the sun and air, the fluid is completely elaborated. By a process which is not fully understood the inorganic material taken up by the plant from the soil is changed in such a way that it can be assimilated by the tissues of the vegetable. The sap is now very much altered in its consistency. A large proportion of water has been evaporated, and the fluid is thick and rich in nutrient matter. Moreover, it will have acquired certain peculiar properties—in the case of the Oak, for instance, these being of an astringent nature. The course which the sap now pursues will take it along the under side of the leaves, through

SUMMER.

The marvellous change which three weeks of spring weather brought about.

the new tissue, and so back to the roots again.

All the summer long the leaf lives a life of intense activity, manufacturing a store of food material which will be put

aside in various parts of the plant. With the coming of the autumn, however, the vitality of the leaf steadily declines, the sap movements become very slight, and the time has come for the organ to be separated from the tree. So far-seeing is Nature, that the leaf is scarcely developed ere preparations are commenced for the severance of it from the twig. Quite early in the history of the leaf at the point of union between the stalk and the stem, a special arrangement of cells is it does not leave a raw and bleeding wound behind such as would be produced by the forcible pulling of the leaf from the branches. The very layer of cells which brought about the separation has also ensured the welfare of the twig from which the leaf has been removed. A thin veil is spread over the point of cleavage, so that there is never any open surface exposed to the air at all. There are few more beautifully contrived processes in the natural world than this fall of the leaf,

CHRISTMAS ROSE IN WINTER.

formed. This has been called the layer of separation, and consists of a number of cells running at right angles to the tissue of older formation. The greater the age of the leaf the more markedly does the line of separation appear, and as the processes of assimilation begin to slacken and the moisture evaporates, the severance of the organ is only a matter of time. Finally, the presence of organic acids so weaken the cells that the leaf will perhaps fall by its own weight; in any case the first gust of wind will be sufficient to complete the fracture.

When the stalk has become detached with which the tree passes into its winter rest. And so the leaves, often brightly coloured as the result of the chemical change which has taken place in their tissues, flutter to the ground —there to lie until decomposition gradually changes them into soft mould. In this way a bed of fine rooting material is formed for future generations of seedlings.

It is, indeed, a wrong impression to consider the autumn as simply a time of decay, for much is accomplished at that period by way of preparation for the following spring. Pull a Chestnut bud to pieces just before the tree loses its

foliage, and it is possible to distinguish the leaves —on a small scale, certainly, but in a wonderfully perfect condition. Several pairs of leaves may be readily distinguished all packed away in downy material, quite ready for the development which will come with the spring. This being so, the protection of the buds against the rigours of winter is a matter of first importance in the life of the plant. Perhaps one of the most obvious features in our Chestnut bud is the gummy substance coating the exterior, and which under the influence of warm sunshine becomes very sticky. This material is most valuable on account of its non-conductive properties, and doubtless plays a large part in shielding the contents of the bud from cold. Apart from this, however, there are several layers of scales which play the chief part in checking the penetration of cold to the immature leaves.

PROTECTIVE BUD COVERING OF A SYCAMORE TREE.

Generally speaking, in nearly all trees these scales represent modifications of leaves which have been arrested in their development or even have partially died, and have thus become horny in texture. In plants such as the Lilac and Rhododendron the bud scales are modifications of entire leaves, and keep green throughout the winter. In one of our deciduous species, the Wayfaring Tree (*Viburnum Lantana*), the lowest leaves of all act as bud scales, and these, owing to a woolly coating, are able to survive through the winter and finally develop as ordinary foliage leaves.

It is a wise provision which has ordained that the tree should become denuded of its foliage before the winter. This season is a time of rough weather, when the strong gales sweep over the country and threaten to destroy all before them. Any of the large forest trees in full leaf would offer a tremendous resistance to the wind and, of course, suffer accordingly. Now and again, when a severe summer gale has visited a part of the country which is wooded, it has been possible to gather some idea of the havoc which a strong wind works among trees in foliage. It is interesting to observe that practically all the so-called evergreen trees which are indigenous to temperate regions produce comparatively small leaves. Of these the great tribe of Conifers are typical, which with their needle-like leaves do not offer serious resistance to the wind.

Apart from the Firs, the trees and shrubs which keep their foliage all the winter produce comparatively small leaves, and these are mostly of specially thickened texture so that individually they may not suffer from wind damage. Round the border of the Holly leaf may be traced a kind of selvedge, formed of thickened layers of cells. This does much to prevent the leaf from being torn in rough weather. The small size of the leaves in the case of these evergreens is also to the advantage of the plant in another way, by preventing snow accumulation. The thick leafy branches of the deciduous trees would provide a lodgment for the falling flakes to such an extent that serious bough breakage would result. The dry particles of snow find little to rest upon in the slender foliage of the Fir or the small, narrow leaves of the Yew.

At all times cold is a great menace to plant life, and a period of severe frost is full of danger to the unprotected vegetable. Yet the low temperature which would threaten to destroy the plant seems to bring about an alteration in the bearing

of the foliage that is valuable as a protective measure. It is seen that during very cold weather many plants droop their leaves, and in this manner prevent a serious loss of natural heat. Most people must have observed how different is the bearing of the Cherry Laurel on a frosty morning to what it is in mild weather. There is little doubt that the leaves would be badly damaged by the cold if they were held out in the normal fashion.

A very considerable number of plants are herbaceous in habit; that is to say they do not form any woody material which lasts through the winter above-ground. In these cases it is seen that towards the end of the summer there is a decided slackening in the activity of the plant, and finally the circulation of the sap ceases altogether. In fact, all the life of the plant vanishes underground. That there is a very real purpose in this behaviour on the part of the herbaceous species is certain; most of these plants are decidedly tender in habit, and few of them are able to produce stems fitted to cope with the rough weather.

Though there is nothing to be seen above-ground when the herbaceous plant has retired to rest, there is a very great deal below the surface. The forms taken by roots are very varied, even if we put aside altogether the underground processes such as bulbs, tubers, and rhizomes, which are, after all, only modified stems. In most cases those parts of the plant beneath the surface are to be regarded as storage chambers upon which the specimen will draw when it is called upon to start its spring growth. With some species the amount of energy stored up is very considerable—sufficient to bring the plant to its maturity if moisture is obtainable. Thus it is seen that a Hyacinth will produce leaves and flowers grown in a vase of plain water.

PROTECTIVE SCALES FROM CHESTNUT BUD.

All through the winter millions of seeds have been lying in the earth. These have remained in a state of suspended quiescence, just in the same condition as when they tumbled, brown and ripe, from the parent plant. It is always somewhat of a mystery as to how it is that the seeds are so well planted. By some means or other Nature generally manages to get most of her seeds covered in before the winter arrives. There is little doubt that the earth-worms take on a large share of the work. During the moist autumn weather these creatures work

comparatively near to the surface, and their countless upheavals of soil go a long way towards covering in the seeds. Seed vessels with long appendages, such as those of the Sycamore and Lime, may often be seen pulled down into the soil, having been treated in much the same way that the worms deal with leaves. Acorns, beech-masts and other edible seeds are stored away in holes in large quantities by small animals, such as squirrels and dormice, which inhabit our woods. The majority of them are forgotten altogether by the little creatures, and many a tree must owe its start in life to the efforts of these tiny gardeners. In addition to the work of these animal agents, the heavy rains of autumn must wash many of the smaller seeds into the soil, whilst the shower of drifting leaves will cover up even a larger number still.

What an alteration is brought about in the condition of the seed by the coming of the spring ! With the increasing powers of the sun the cold earth becomes warmer every day, and this rise in temperature is the signal for which the seeds have been waiting. The gentle showers of spring water the earth, and the moisture soaking inwards through the husks of the seeds, stirs the living matter to activity. As we shall see elsewhere, the store of food materials is at this time converted into a form available for the immediate use of the little plant-to-be. It is interesting to see how cautiously the plantlet puts in an appearance at first. The small stem arches its way through the ground, and the tender leaves hang down, until they are more developed. During the spring weather, which is usually of a fickle character, we may feel certain that the drooping, huddled bearing of the seedling's initial leaves affords a real protection against cold.

In defiance of weather conditions a few plants have elected to come to perfection right in the middle of the winter season. Of these the Christmas Rose (*Helleborus niger*) is perhaps one of the most striking examples. It is interesting to see the manner in which the flowers of this plant are protected, so that they may not suffer from the cold rains of December. The bud of the blossom is of a pendulous habit, and even when the

SUMMER: SHOWING ALL THE AQUATIC PLANTS ABOVE THE WATER.

flower is fully expanded the essential organs are perfectly sheltered by the encircling sepals. In passing, it may be mentioned that the petals of the Christmas Rose are contracted into small linear bodies, hardly exceeding the stamens in size. The flowers of the Hellebore seem to be able to hold over their own development for almost any length of time without injury until a fairly favourable spell of weather arrives.

The earliest arrivals of the springtime will often have to cope with spells of bad weather. That typical flower of the new year, the Snowdrop, is well adapted to meet almost any conditions. Owing to its drooping habit the close-fitting petals form a most perfect little roof to protect the delicate essential organs. A few weeks later, when the Crocuses put in an appearance, there will be more sunshine, but the weather is still in an uncertain state. Note the white protecting sheath which encloses the whole shoot until warmer conditions makes it safe for the leaves and flower-buds to venture out. When quite open the Crocus-blooms face right up to the sky and are exceptionally exposed, but it is only in direct response to the solar rays that the flower will display its shining corolla. On dull threatening days the floral envelope is tightly closed, so that there is no possibility of any harm coming to the golden anthers. In much the same way the golden-yellow Coltsfoot, one of the earliest of our wild flowers, is so sensitive that it never by any chance opens unless the day is bright and warm.

S. Leonard Bastin.

WINTER: ALL THE PLANTS DISAPPEAR BELOW THE WATER.

FEMALE OF THE GREAT GREEN GRASSHOPPER.

BRITISH GRASSHOPPERS

By DOUGLAS ENGLISH, B.A., F.R.P.S.

Illustrated with photographs by the Author

THE Praying Insects or Mantids, Leaf and Stick Insects, Cockroaches, Earwigs, Short-horned Grasshoppers, Long-horned Grasshoppers and Crickets, constitute a somewhat heterogeneous Insect Order known as the Orthoptera.

The Order admits of a natural division into two groups. The first of these embraces insects whose hind-legs are not markedly disproportionate, and whose normal method of progress is, as their name Cursoria suggests, a run.

Of this group we have about a dozen indigenous species. Three are Cockroaches, all, fortunately, of an out-door habit, and the remaining eight or nine are Earwigs. Of recent years several species of Stick insects have been successfully bred in this country, and records of their capture at large, more especially in the western counties, whose climate apparently suits them, have been not infrequent. It is possible that they may permanently establish themselves, and there seems to be no reason why an attempt to introduce some of the quaint, consequential, and, it must be confessed, somewhat uncanny-looking Mantids should not be equally successful.

The members of the second group are known scientifically as Saltatoria, and popularly as Grasshoppers, or Locusts. In the majority of them the development of the hind-legs ensures a remarkable leaping power, but is a serious handicap to any other method of progression. We have in this country about a dozen Short-horned Grasshoppers (diminutive Locusts), nine Long-horned, and four Crickets. Our lists are not infrequently increased by the sporadic appearance of Continental species, some of which may have been blown over, while others have been accidentally included in consignments of fruit and vegetables.

For an interesting record of the latter accident I am greatly indebted to Mr. O. H. Latter, the species in question being a male of *Acridium Ægyptium*, a South European Locust, who emerged from a hamper of cauliflowers imported in 1904 by a Godalming greengrocer. A cattle drover was called in—presumably armed—but the result of his good sense in bringing the insect to Mr. Latter alive, is that I am enabled to include a picture of it set so as to display the remarkable attitude which it adopts when frontally attacked. Mr. Latter's description is that it "swings its hind-legs forward and makes a vicious upper cut" with the spines which arm its shins. The force of this slash, or kick, is sufficient to draw blood from the finger.

TWO MALE BUSH-CHEEPS (*T. CINEREUS*) PREPARING FOR COMBAT.

It should be noticed that this Short-horned Locust is an enlarged edition of our Common Field Grasshopper, and it may be well to point out that all "Locusts"—using the word in its generally accepted meaning — have *short* antennæ, and for this reason are referred to the Acridiodea, not, as might reasonably be supposed, to the "Long-horned" Locustidæ.

Though, with the possible exception of the Great Green Grasshopper (*Locusta viridissima*), none of our British Saltatoria are sufficiently well armed to do any but trivial damage to the human hand, there can be little doubt that the twin rows of spikes on a Grasshopper's shins, which terminate just in front of the tarsal joints with two or more quite formidable spurs, serve, in some fashion, as offensive or defensive weapons. In the case of our small Field Grasshoppers the extreme ease with which the hind-leg is dislocated at the hip-joint precludes the likelihood of their habitually kicking in self-defence. The only British insect who, in my experience, kicks with a will is the sturdily built Field Cricket.

Grasshoppers most frequently display their resentment by the emission of a dark coloured fluid from the mouth. I have no knowledge of the chemical composition of this fluid, but the fact that, in the case of one magnificent Long-horn (*Decticus verrucivorus*), it is used as a remedy for warts, points to the likelihood of its being corrosive.

The great variation of colour in Short-horned, as opposed to Long-horned Grasshoppers, may be a general protective adaptation to their surroundings. A leaf-green body colour is, of course, a specialisation, and is to be met with chiefly in Long-horned Grasshoppers who habitually perch in the green some distance above ground level—in *Leptophyes punctatissima*, for example, who affects the sunny side of high nettles; in *Meconema varium*, a "tree" Grasshopper mostly found on the oak and hazel; in *Xiphidium dorsale*, and in the Great Green Grasshopper

(*Locusta viridissima*). The only brown Long-horned species at all common in this country is the Bush-cheep (*Thamnotrizon cinereus*).

Short-horned Grasshoppers seldom give one the impression of being green all over, and a close inspection usually shows that their colour is composite in origin, and that it depends partly on the development of their wings, and partly on individual variation. As an aid towards the distinction of species the colour of Short-horned Grasshoppers is therefore of little importance, though it may perhaps be mentioned that *S. viridulus* has a greater tendency than any other common species to being a delicate rose-pink.

The differences between Long-horned and Short-horned Grasshoppers are not confined to external structure, but extend to habits which would seem to be, in a sense, independent of structure. The epithets "Long-horned" and "Short-horned," of course, have reference to the antennæ, which, when perfect, are considerably longer than the body in the adult Long-horn, and in the immature so much longer that one wonders at the ability of the little creature to control them. The numerous segments of which these antennæ are composed can be distinguished with a pocket lens, and in certain species, *M. varium* and *L. punctatissima*, for example, they are beaded at every sixth or seventh joint. The antennæ of our Short-horned Grasshoppers, which are always shorter than the body and never have more than twenty-five to thirty joints, are important as affording a generic distinction. In most British districts the "myriad cricket of the mead" is a Short-horned Grasshopper, whose thread-like antennæ vary very slightly in thickness from the base to the tip. This regularity in thickness stamps their owner at once as belonging to the genus *Stenobothrus*. It is probable that he will be either *S. viridulus*, who, as has been mentioned, is often pink, or *S. bicolor*, who is often the same colour all over. Should, however, a Grasshopper be taken whose antennæ are clubbed at the tips, he must be referred to one of the three species of *Gomphocerus*, and he is most likely to be *G. maculatus*, a small, spotty, greenish Grasshopper who is not uncommon. It needs sharp sight to distinguish the number of tarsal joints on a Grasshopper's foot, but it is distinctive of Short-horned Grasshoppers that these should be three in number, whereas in Long-horned Grasshoppers they are four.

To distinguish between the sexes of Short-horned Grasshoppers needs a very careful examination and some knowledge of insect anatomy. The mature female Long-horn, however, is distinguished at

THE GREAT GREEN GRASSHOPPER (*L. VIRIDISSIMA*) INVESTIGATING A SHORT-HORN (*STENOBOTHRUS*).
The relative size of the two species can be well seen.

once by the remarkable prominence of her ovipositor, and, in some species, by the absence of wings. The ovipositor, which may be described as "sabre shaped," and whose form in different species can be seen in the illustrations, consists of two similar and parallel blades (formed by the fusion of several others), which admit of sufficient separation to allow the passage of an egg between them, and whose rigidity, when closed, permits of the insertion of the instrument up to the hilt in some suitable crevice. In depositing eggs the Long-horned Grasshopper straddles across the hole selected and bends the ovipositor downwards. I fancy that most British species lay their eggs in the ground, but it is said that *M. varium* lays in oak-galls, using, of course, the hole through which the gall-fly has emerged.

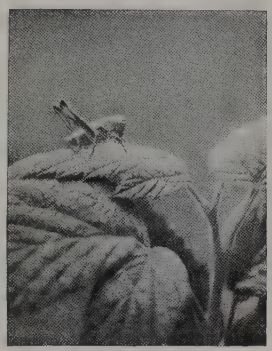
The development of the ovipositor in the female is like the development of wings in the male—deferred until the insect is nearly mature.

The metamorphosis of Orthoptera is incomplete. The transitions—larva to pupa or nymph, and nymph to imago—are so gradually accomplished that it is impossible to fix dividing lines between them. Perhaps the first rudiments of wings mark the attainment of the nymph or pupal stage.

The growth of young Grasshoppers, who hatch in late spring and early summer from eggs which have in most cases been deposited in the previous autumn, is assisted by a series of complete moults. These extend over a period of about two months, and are usually six or seven in number. In the case of *T. cinereus*, and *L. punctatissima*, I have seen the insect devour its cast-off skin with evident relish.

In *L. punctatissima* the appearance of the ovipositor is startlingly sudden. It springs out fully formed, giving one the impression that it has been lying concealed, possibly folded back under the old skin, for some time previously. At each subsequent moult its form is modified, so that apart from the inevitable deformations which occur after death, considerable caution is needed in distinguishing the species of even live Grasshoppers by the shape of their ovipositors.

1



2

1, LARVA; 2, NYMPH OF THE BUSH-CHEEP (*T. CINEREUS*).

Immediately after a moult, a Grasshopper is a limp, anæmic-looking creature, who is rendered peculiarly helpless by the softness of his integument. Until this has been hardened by exposure to the air (it may be mentioned that his hind-legs are nearly as soft and flabby as the rest of him), he is incapable of violent movement, and is consequently defenceless. The process of hardening is, however, a short one. Within twenty minutes or so he will be found to have recovered, indeed, improved upon his previous colour, and to be in the pink of athletic condition.

Short-horned Grasshoppers are fair fliers when the wind helps them, though they seem quite incapable of steering a definite course. In connection with their breathing apparatus—a system of air tubes (*tracheæ*) whose communication with the atmosphere is effected by rows of air

1

2

4

3

5

(1). THE TREE GRASSHOPPER (*MECONEMA VARIUM* ♀).
(2, 3). THE BUSH-CHEEP (*THAMNOTRIZON CINEREUS* ♂).
(4). THE NETTLE GRASSHOPPER (*LEPTOPHYES PUNCTATISSIMA* ♀).
(5). THE BUSH-CHEEP ♀.

In 1, 4, 5 the ovipositors should be noticed, in 2 the stridulatory apparatus in the form of scale-shaped elytra on the back.

holes (*spiracles*) on the sides of the body—they possess, like dragon-flies, bees, and many other flying insects, internal air-sacs which are capable of considerable expansion. It would appear that the dilation or contraction of these air-sacs is, in part, controlled by the insect and, in part, dependent on the space occupied by food and so forth in the insect's body.

In the destructive migrations of Locusts, which occasionally cause enormous damage to vegetation, it is probable that there is little true flying. The insects wait for a favourable wind, and, on its arrival, allow themselves to be wafted upwards and carried in the desired direction. Their muscular exertion is confined to travelling as far as may be on an even keel. It is an observed fact that a change of wind causes a swarm of Locusts to come to earth, and their ability to do this seems most easily accounted for by assuming that they have, when their bodies are empty (migration would be otherwise unnecessary), a fairly complete control over their air-reservoirs. The appearance of an approaching swarm of Locusts has been likened by several observers to that of a snowstorm, and the weight of one particular swarm which passed over the Red Sea in 1889 was estimated at 42,850 millions of tons!

Dilatable air-sacs appear to be either rudimentary or wanting altogether in Long-horned Grasshoppers, and it is perhaps this deficiency which prevents their migrating, like Locusts, *en masse*, and which inclines them to a mixed diet of animal and vegetable food. Several of our Long-horns possess an ample expanse of wings, but none of them can be termed strong flyers. The utmost that can be said for the wings of either *L. viridissima* or *M. varium* is that they serve to break a fall. *L. punctatissima* has no wings to speak of; neither has *T. cinereus*.

THE SMALL WOOD GRASSHOPPER (*TETTIX BIPUNCTATUS*).

At the top are two cabinet specimens which have not been in any way posed for the camera. The distinctive form of the live *Tettix* can be well seen in the two lower illustrations.

I am inclined to think that British Long-horns are normally insectivorous when mature, and that they wait for their prey to come to them. Sometimes they will slowly advance to the attack (I have seen the Great Green Grasshopper so stalking a Burnet Moth), and, if the object aimed at happens to be asleep, he will be eaten—or at least the fat portion of him, the wings being, as usual, pulled off and thrown aside.

Besides the distinctive differences between Short-horned and Long-horned Grasshoppers which are to be found in the length of their antennæ, the development of their ovipositors and the nature of their food, a further and important difference exists in the character and mechanism of their chirrup. Mr. Malcolm Burr, to whose "British Orthoptera" I would refer the reader for an excellent systematic account of British Grasshoppers generally, describes the "chirrup," or stridulation, of three common Shorthorns as follows: *S. viridulus*—loud and prolonged, beginning low and gradually rising until it has reached a certain pitch; *S. bicolor*—a short "tzz-tzz-tzz"; and *S. parallelus*—"tss-ssz-szz-zzz-zz-z." The last phrase I must confess perplexes me, but I am relieved to find that British entomologists have as yet declined to follow the Americans in reducing Grasshopper notes to formulæ in which T = the temperature of the air, H the humidity, N the number of stridulations per second, and so forth.

In Short-horned Grasshoppers stridulation is effected by the friction of one hind-leg against the elastic edge of the wing-cover on the same side of the body.

To accomplish this the shank is brought up close against the thigh, and a quick fiddling motion imparted to the whole flexed limb. Its sharp edges, which in some species are beaded, grate on the edge of the wing-cover, and the variation of note in different species is to be accounted for partly by the specific difference of veining in the latter and partly by the structure of what is termed the "ear." This, in the Short-horned Grasshoppers, is situated on the first segment of the abdomen immediately above the articulation of the hind-leg and in front of the first spiracle. All that is externally visible in the common British species is a more or less oval depression. Within this is a tympanum or drum of tense membrane, which is described by Graber as having on its inner face two processes connected with a bag of clear fluid. The latter is in turn connected with the "auditory" nerve. That the whole is a sense-organ of some description admits of little doubt, and it is as likely as not that it may be an organ of hearing.

SHORT-HORNED FIELD GRASSHOPPERS (*S. VIRIDULUS*).

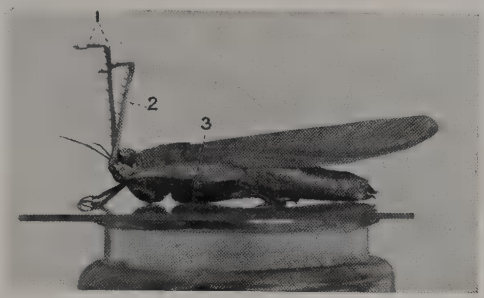
It is present in both sexes. If, therefore, we may assume that it affords a means whereby the female shall hear the male, we may also assume that it affords a means whereby the male shall hear the female.

I have never traced stridulation to a female Short-horn, but I know of no reason why she should not stridulate. Considering the complications which would arise if both male and female Grasshoppers sang one and the same tune; considering, too, the possibility of sympathetic tones ("resonators") linking the two sexes together—it is likely enough that female stridulations are not only invisible to human eyes but also inaudible to human ears. Many people are incapable of hearing even the male Grasshopper, though to others the shrillness of his song is almost painful. Forty thousand vibrations per second (the top note of the pianoforte gives perhaps four thousand) is considered to be the limit of human audition.

In the case of one peculiar genus of Short-horned Grasshoppers, known as *Tettix*, stridulation, if it is accomplished at all, must be accomplished by a different mechanism. *Tettix* is unique in several respects. To begin with, he is honoured with one of the few pure Greek words used in scientific nomenclature, though it is doubtful whether the golden "tettiges," which, according to tradition, the Athenians wore in their hair to signify that they were autochthonous, were modelled on Grasshoppers or Cicadas. Both may be said, in a sense, to spring from the soil, for both deposit their eggs below the surface. As a modern name for a genus of Grasshoppers, *Tettix* appears to have been first employed by the great French entomologist Latreille, and his countrymen—it would be difficult to overestimate the debt of entomology to French genius—appear to have vied with one another in naming the various species after devils. We find, for instance, in the old books *Tettix Lucifer*, *Tettix Beelzebub*, *Tettix Belphegor*, and *Tettix Asmodæus*. The reason for this nomenclature is not, as might be supposed, the preference of *Tettix* alive for warm surroundings, but the blackening and shrivelling of *Tettix* dead. The suggestive appearance of the cabinet *Tettix* may be seen in the illustration.

The living *Tettix* can be easily recognised by his small size, his sturdy build, and the lozenge-shaped appearance of his back, which is due to a hindward prolongation of the pronotum. We have two British species—*Tettix bipunctatus*, who has a roof-shaped pronotum and short wings, is extremely common; while *Tettix subulatus*, a more slender but equally short insect with a long, nearly flat pronotum and large wings, appears to be somewhat local.

Tettix bipunctatus, of whom alone I have certain knowledge, is a cheerful, robust little Grasshopper, who is active early in the spring, lingers late into autumn, and may possibly hibernate. He affects clearings in woods, and in suitable localities occurs in profusion. As one would expect from the development of his thighs, he is a prodigious jumper, but it should be noted that, contrary to the general rule among Grasshoppers, he has no resilient pads on his feet. One seldom finds a specimen with other than quite rudimentary wings, and I have never seen one fly. In colour he shows extraordinary variation; browns and blacks predominate, but they occur in many shades and in many different dispositions. The pronotum completely hides the wings in all ordinary positions; so that if stridulation is accomplished at all by the hind-legs, it must be by scraping on the pronotum.



ACRIDIUM ÆGYPTIUM (*see p. 869*)
1. The tarsal joints. 2. The tibia (shank).
3. The femur (thigh).

The stridulation of Long-horned Grasshoppers, which is of much greater carrying power than that of Short-horns, and is more closely allied to that of the Crickets in phrasing, is effected by the friction of the under surface of one wing-cover—usually the left—over the upper surface of the other. Stridulating wing-covers, which, as far as British Grasshoppers are concerned, exist only in the males, are partly, in some cases wholly, composed of tense, semi-transparent membranes stretched on stout branching nervures. The upper (left) cover is generally provided with a "rasp" nervure which engages with the edge of the lower (right) cover and so engenders a "shrill," which is intensified by the structure of both, and particularly by the presence in the latter of a semi-transparent circular "speculum."

The "shrilling" of the male Long-horned Grasshopper may be heard at any time during still warm weather, but is most in evidence towards sunset, and may be prolonged far into the night. It is often difficult to locate. The note of *T. cinereus* (the Bush-cheep) resembles the squeak of a shrew mouse. His usual pitch is an inch or so above ground level at the bottom of the hedgerow. During the day time he often creeps out to sun himself, but so wary is he, and so quick to get to cover, that it needs a smart hand to catch him—and miss the thorns. It has been stated that the male of *T. cinereus* is somewhat rare. This has not been my experience, but I think that there are fair grounds for supposing that in the case of Long-horned Grasshoppers and Crickets there is a tendency for the males to predominate in one brood, while the females predominate in another.

The "ears" of Long-horns are situated at the top of the tibiæ (shanks) of the fore-legs; those of Crickets have a similar position. There is a decided tendency among Long-horned Grasshoppers to sit above ground level. They therefore affect the hedgerow, the nettle bed, and the coppice. Short-horned Grasshoppers prefer the grass. Either may trespass on the other's preserves; indeed, it is not unusual to find the Great Green Grasshopper at some distance from even a bramble bush. In certain favoured places in the south of England, one may count on finding *Stenobothrus* and *Gomphocerus* in the grass, *Leptophyes* in the nettles (by sweeping), *M. varium* on the hazels (Bignell's Tray), and *L. viridissima*, for all his protective coloration, moving one hind-leg, and so staring one in the face half-way up the hedgerow. I have already mentioned the wood clearing for *Tettix*, and the bottom of the hedgerow for *Thamnotrizon*. The latter is often in the heart of the wood also, and it is in small circumscribed sunny clearings that one has the best chance of taking him in all stages of growth.

DOUGLAS ENGLISH.

HOW TO KNOW THE SEASIDE FLOWERS—II

By the Rev. H. PUREFOY FITZGERALD, F.L.S.

Illustrated with Photographs by HENRY IRVING

IN a former article I dealt with a familiar group of seaside flowers to be found in most places around our coast. I now present a second group of interesting plants which, with a little search, visitors to the seaside may frequently discover.

SEA MILKWORT

The Sea Milkwort (*Glaux maritima*), or Black Saltwort, as it is sometimes called, is a little, low-growing plant, very common on sandy and muddy shores and in salt marshes. It is a pretty plant, and is well worth the risk of wet feet to find it. There is no relationship, except in name, between it and the Milkwort of our heathy ground, and very likely few would place it, on first sight, in the family of the Primroses (*Primulaceæ*). The Sea Milkwort seldom grows more than five or six inches in height; it is a humble little flower, and prefers rather to creep along the ground; the tiny rose-coloured flowers are produced in the axils of the leaves. There are no petals, the sepals being coloured instead, and appearing to be a corolla.

SCURVY GRASS

Flowering throughout the summer from May to September, the Scurvy Grass (*Cochlearia officinalis*) is not uncommonly to be found growing on the muddy shores by the sea. It is more common in Scotland than in England or Ireland; it does not often grow very large, seldom exceeding six inches in height. The whole plant is smooth and, as is generally the case with flowers growing in like localities,

SCURVY GRASS.

THRIFT.

somewhat fleshy. The leaves that spring from the roots are all stalked, kidney shaped, and deeply heart-shaped at the base. Those growing on the stem are for the most part sessile ; the base clasps the stem, and the whole leaf assumes a rather angular shape with a few large teeth. The flowers are above half an inch across, white, with sometimes a dash of purple.

Many explorers have found the Scurvy Grass to be of very great use in keeping off and curing scurvy; the plant holds in its tissues an oil with a bitter taste, which has proved to be a good remedy for the disease. Probably any other green food, if it had been available, would have been just as efficacious. The name *Cochlearia* comes from the Latin word for a spoon, and refers to the shape of the leaves.

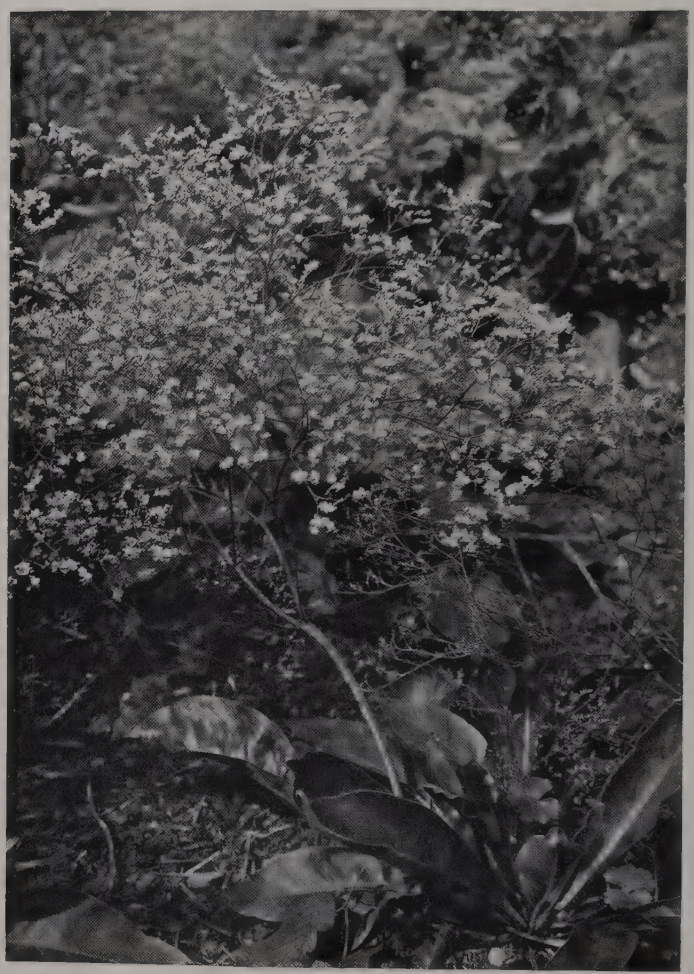
THRIFT

The Thrift, which was formerly known officially as *Armeria vulgaris*, but is now called *Statice maritima*, is a well-known plant in gardens, being frequently used for making an edging—and a very good one it makes when the soil suits it. Prior, in his book on the origin of plant names, states that the popular name is part of the old verb *threave*, or *thrive*, to press close together, and refers to the dense tufts which the plants make. The Thrift is a member of the Plumbago family, of which this plant and the Sea Lavenders are the only British representatives. Pliny mentions it under the name of *Statice*, which is derived from the Greek words signifying *to stop*, as this plant, by growing in sandy situations, is found to retain and stop the movement of the sands. In the time of Queen Elizabeth it was called "Ladies' Cushion" and Sea Gilloflower, and now it is often termed the Sea Pink. The leaves are all narrow, and have a prominent midrib. They form a thick rosette on the ground. The flowering stems grow from three to six inches high, and each one bears a globular head of pink flowers. The colour is somewhat variable, and may be found as deep rose or white.

The Thrift is to be seen growing in most seaside places, either on the shores or rocks, and also on the higher pastures. It is found, too, on the tops of some of the Scottish mountains. When growing in a mass, and when in full bloom in summer, the pink tinge of colour is very effective. Another species, *Statice plantaginea*, with broader leaves, each one with three or five nerves running up them in a parallel direction and with a taller flowering stem, is to be found in the Channel Islands.

SEA LAVENDER

The Sea Lavender (*Limonium vulgare*) belongs to the same family as the Thrift, and it formerly used to bear the name of *Statice* when the Thrift was called *Armeria*. Most people will know this plant, or some of its congeners; many of them are grown in gardens, and form a welcome addition to the flower borders because of the lavender tint of the heads of flowers. These are of a dry nature, and consequently retain their form and colour for many months, and help to decorate the winter bouquets.



SEA LAVENDER.

The rootstock is sometimes very thick, and rather fleshy; the leaves are all stalked and vary very much in size, attaining a length sometimes of nearly a foot, they vary also in width, some being narrow and others broad. The forked flower stem rises erect from the root and is generally much branched. The flowers are very numerous, of a bluish purple colour. The upper part of the calyx is also tinted with purple, and after the blossoms have been out for some little time, the calyx expands and becomes enlarged, so that it may be mistaken for the true corolla. The Sea Lavender flowers during July and August. The flowering period would seem to be longer because of the peculiarity just

SEA MILKWORT.

mentioned; it is one of the handsomest of our maritime plants, and should be looked for on muddy and sandy shores and in the salt marshes.

KIDNEY VETCH

The Kidney Vetch, or "Lady's Fingers" (*Anthyllis vulneraria*), is one of the Leguminous family; it is included here because it grows in great abundance on the cliffs and in the pastures near the sea; but it is also very common inland. The dense heads of flowers are generally in pairs (at the top of the stem). The blossoms are either yellow or reddish; the colour seems to depend very much on the soil in which the plants are growing. The calyx is inflated and very hairy, as indeed is the whole of the plant; it is this soft, inflated calyx that is the origin of the name "Lady's Fingers," as several of them together are supposed to resemble gloved fingers.

PENNYWORT

Those who have been along the south coasts will have probably come across the Pennywort or Navelwort (*Cotyledon umbilicus*), with its round, fleshy leaves supported on the top of the leaf-stalks. The flower stems grow sometimes nearly a foot high, and bear a long succession of pendant, yellowish-green blossoms. The succulent nature of the plant proclaims it at once to be a member of the Sedum or Stonecrop family (*Crassulaceæ*). It seems to enjoy growing amongst rocks and on old walls, and flowers from June to September.

PENNYWORT.

ABOUT THE JACKDAW

By BENJAMIN HANLEY

With a Photograph by the Author

IN the flocks of rooks flying overhead, particularly during the winter months, numbers of smaller birds will be noticed which have a much quicker flight than the rooks, and every now and again they give vent to a cry something like "chack-chack" or "jack-jack." These are Jackdaws, which consort a great deal with rooks at their feeding grounds. When close at hand it will be seen that there are many points of difference apart from size; the Jackdaw has the face fully feathered and a much shorter beak. The crown is deep velvety black, and in the adult the neck is grey and the eye pearly white; these contrast with the otherwise dull black plumage.

THE JACKDAW

Like the rook, the Jackdaw builds a nest of sticks, but unlike that bird it is placed out of sight in the hollow branch of some tree, an old church tower, or hole in the side of a cliff.

If undisturbed the birds return year by year to the same nesting haunt, and each season add considerably to the materials used for nest building, so that in the course of time almost a cartload of rubbish may be collected. The eggs, sea green with many black spots, are usually five in number. The young make interesting pets, and if taken before they leave the nest become very tame, so that there is no need to pinion their wings or confine them in any way. It should be added, however, that they learn many mischievous tricks, until in some cases the owner is either obliged to give them away or keep them in captivity.

I know of one case where the bird had a fondness for collecting and hiding bright things in the thatch of a cottage. This was tolerated so long as it took nothing of greater value than safety pins or such-like objects, but when it began to make off with silver coins, and not confine its depredations to its owner's property, some restraint had to be put upon it.

They learn to repeat certain words quite easily. At one time a belief was prevalent that to make them talk properly the tongue should be cut with the edge of a sixpence. Such a cruel method is, of course, absolutely useless as far as assisting the bird to talk is concerned.

A RHODODENDRON POND.

From a Water-Colour Drawing by Miss Beatrice Parsons.

LEAVES AND FRUITS OF COMMON BUCKTHORN.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—II

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE SPINDLE-TREE AND THE BUCKTHORNS

THE Spindle-tree, as its name indicates, may attain to the distinction of a small tree, but its usual habit is that of a shrub merely. Its name dates back to the time of the universal spinning-wheel, when its wood was chiefly utilised in the manufacture of spindles. For the greater part of the year it claims little attention, being generally mistaken, through casual observation, for the more familiar Privet. But with the coming of autumn there can be no such lack of regard. With the fading of the leaves the handsome four-chambered fruit takes on its special colouring of rosy pink, deepening and brightening as the leaves fall away till the bush is all aglow, conspicuous from afar.

One of the pleasantest surprises, with the increasing greyness of the shortening days, is to come suddenly upon a Spindle-tree, leafless, but crowded with what might seem to be an array of lovely waxen flowers. This fancy is only more assured by closer inspection. Each fruit hangs gracefully suspended by a slender stalk, and the

four opened cell-walls may readily be likened to expanded petals; whilst the enclosed seeds, now exposed to view, accentuate the floral resemblance with their vivid orange colouring—"The fruit which in our winter woodlands looks a flower."

The twigs are matt green in colour, and so remain for several years. Indeed, even upon the main stems lines of green show faintly through the prevailing grey. Four slender ridges, running lengthways along the twig, give to it a four-angled appearance. The small buds, arranged in opposite pairs, are oval, pointed, and protected with scales. The leaves are a long oval, but taper to a point, both at the base and tip. They have one main rib, from which branch off about eight pairs of secondary ribs. These are slender, and curve forward, looping one into another near the leaf margin. The margin is finely toothed.

The flowers, which are in small branched clusters, spring from the points of junction of the leaf-stalks and the shoots. Individually, they are small and incon-

BUCKTHORN GROWING AS SMALL TREE.

spicuous. They have four greenish-white petals, projecting in the form of a cross from the margin of a fleshy, central disc. Four stamens stand erect upon this disc, alternating with the petals, and in the centre of all is the pistil. Nectar lies exposed upon the disc. The insect visitors are chiefly flies. The fruit is, as already indicated, a four-celled capsule, rosy pink in colour, which splits open lengthways of each cell, exposing one or two orange-coloured globular bodies in each. These are the seeds, in pulpy coating, rendered thereby attractive. They are eagerly extracted by blackbirds and thrushes, but are poisonous to man.

THE BUCKTHORNS

There are two of these. In general character they are much alike, but a closer scrutiny shows many and well-defined differences. Both may become small trees, but they are usually met with as shrubs. They are the Common Buckthorn, also spoken of as the Purging Buckthorn; and the Alder Buckthorn, or Breaking Buckthorn. The name Buckthorn is but an Anglicised misspelling of the German "Buxdorn," which is Box thorn, or thorny Box.

The Common Buckthorn has a preference for a chalky or limestone soil. It possesses thorns, and for this reason, in the leafless condition, may be mistaken casually for the common Sloe, or Blackthorn. The appearance and arrangement of the buds will at once serve to distinguish these two. Those of the Blackthorn are rounded and blunt, frequently occur in clusters, and are arranged spirally upon the twig. The buds of the Common Buckthorn are long and pointed, pressed up against the twig, on which they are arranged in nearly opposite pairs, having this peculiarity that they seem as though they had been slightly pushed out of position. They are dark brown in colour, and are protected by scales. A thorn frequently appears at the end of the shoot, projecting between two tightly-pressing buds. When these buds grow out into shoots, one on either side, the thorn remains standing in the fork which results.

The leaves are a broad oval, rounded at the base, with a supplementary point attached at the apex. Three pairs of secondary ribs branch out from the midrib, but from the lower half of it only. These all curve forward, converging towards the apex in a manner similar to those of the Dogwood. The margin is very finely serrated. The flowers, which grow in tufts at the base of the young shoots, have four very minute greenish petals. Pollen-bearing flowers here are distinct from those producing fruit, and these, as a rule, appear on different shrubs. Some shrubs, in consequence, yield no autumn fruit. The fruits are bunched at the base of the current year's shoots. They are

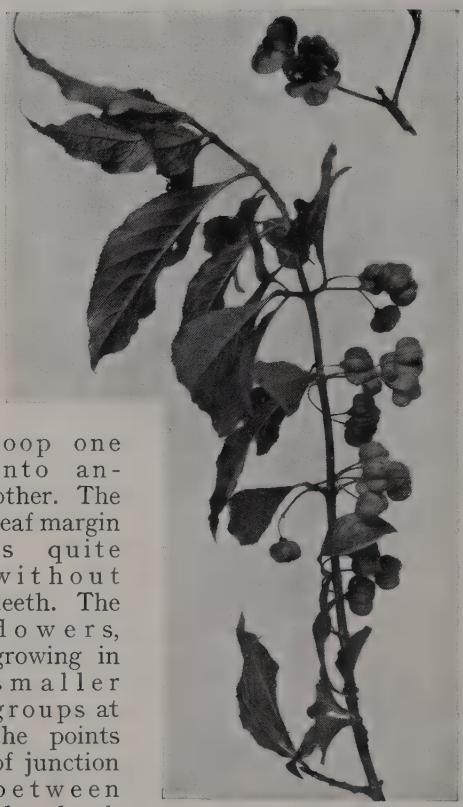
LEAVES AND FLOWERS OF ALDER BUCKTHORN.

1. TWIG WITH SPINES OF COMMON BUCKTHORN.
2. TWIG OF SPINDLE.

globular, black in colour, and possess, each of them, four stones.

The Alder Buckthorn is not very happily named, since it has little, if anything, in common with the Alder beyond the fact that it chooses a moist soil to grow in. It is generally found on clay or loam, rather than on chalk. The buds are small, and without scales, being protected by narrow, downy stipules, which give them a grey appearance. The twigs are downy at the tips, and are usually violet-brown in colour. There are no thorns. The arrangement of the buds shows a remarkable variation. In the central portion of the twig the buds distinctly alternate, whilst below and above they stand nearly in opposite pairs.

The leaves, somewhat thin and smooth in texture, and of a paler colour on the under surface, are of similar shape to those of the Common Buckthorn, but the venation is distinct. About eight pairs of secondaries branch out from the midrib at points about equally distant, and along its whole length. These secondary ribs are straight and parallel till nearing the margin, when they loop one into another. The leaf margin is quite without teeth. The flowers, growing in smaller groups at the points of junction between the leaf-stalks and the shoot, are consequently disposed more or less along its whole length. Each has five small white petals, and is complete, possessing both stamens and pistil, so that here there is no distinction of a fruiting and non-fruiting shrub. Flies, again, are the chief visitors. The fruits, rather larger and less bunched, are also globular, and black in colour when ripe. Each contains two (or three) stones.



FRUITS OF SPINDLE.

LEAVES OF SPINDLE.

The presence in the spring, and again in the autumn, of a Brimstone Butterfly is generally a safe indication of the near neighbourhood of Buckthorn, this shrub providing the foodstuff of the Brimstone's caterpillars.

The Sea Buckthorn, allied in name only, is of local occurrence. Its leaves are willow-like. Its fruits are yellow berries.

FOUR DRONE FLIES WITH A HIVE BEE IN CENTRE.

THE FLY AND ITS HABITS

By R. A. STAIG

Illustrated from Original Photographs by JOHN A. BALLANTYNE

FLIES have never been favourites. Innate, or accidental, the tiresome ways of the few have earned opprobrium for the whole order; and so it has come about that the two-winged Fly is commonly regarded rather with aversion than with interest.

Like other living things, it arises from an egg—not straightway becoming the perfect winged form, but gradually, by a wonderful creative process of transformation, evolving through two transitional beings, both dissimilar, and neither the one nor the other superficially suggestive of the future Fly.

Very small and seldom seen are the eggs of the Common House Fly; unconsidered trifles, much too minute for average eyesight and rarely found in pleasing places. Were it easy to look within these sculptured spindles we would see the most delicate imaginable streak of living matter in a state of ceaseless activity, building up a body; the astonishing formation of a maggot from a mere speck of that marvellous vital substance, protoplasm—and within less than thirty-six hours. Living amid ugliness and in obscurity, a strange creation is the white maggot—a limbless object with a tapering, mobile "neck," almost headless, but possessing a mouth; well adapted for the particular business of its brief existence, to consume the refuse where it was born. Five or six days is the duration of this larval state, then it becomes quiescent and undergoes phenomenal change. Every structure internal is broken down completely. That which was the maggot seems to be again an egg, for within the skin capsule filled with the creamy products of destruction nothing remains of the original organisation save some remnants; but out of these, and from

THE CLEG, OR STOUT (*HÆMATOPOTA*).
(Magnified two diameters.)

the reconstruction of the living débris, is formed the nymph or pupa which, six or seven days after the passing of the maggot, emerges as *Musca domestica*.

Thus within three weeks during the warmer months of the year any one Fly female may give rise to no fewer than one hundred or one hundred and fifty individuals, for such is her egg-laying capacity.

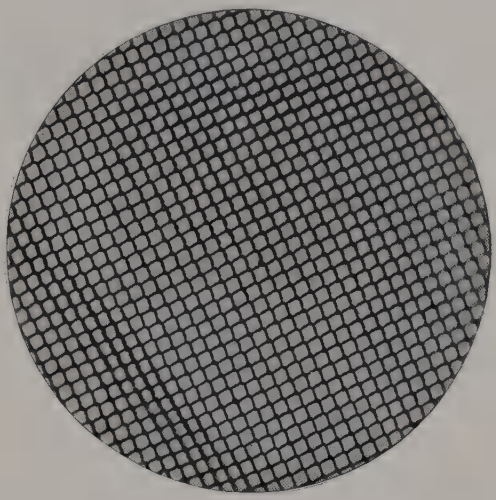
A feature of the Fly is its face—merely a depressed vertical strip between the two great eyes which are close together, and which, being wide in extent, enable the Fly without moving to see in front, below, and above, somewhat sideways, also fairly well round a corner. Slight magnification shows the numerous facets forming the eye surface; but with the aid of the microscope it is found that each one is the outer portion of an underlying lens, and the astonishing discovery is thus made that what at first sight seemed a large single eye is actually a combination of four thousand or more massed together to function as one.

TRUNK OR PROBOSCIS OF FLY.
(Magnified.)

Watch a House Fly settle anywhere, and it will presently begin dabbing with its long cushion-tipped trunk, selecting tasty motes invisible to the human eye, and quite likely, at the same time, innocently transferring equally invisible but highly noxious germs casually carried from some recent place of call. The lips, tongue, and other mouth-parts have all been utilised to form this useful instrument by means of which the Fly takes, or rather siphons, up its food, and with which it can explore where it could not possibly put its head.

For long it was a mystery how the Fly, "turning gravity to jest," walks and runs so easily along a ceiling, or up and down a perpendicular piece of glass. The two pyriform pads beneath the terminal claws of each foot were supposed to act like suckers when applied to polished surfaces; but a closer inspection of the pads revealed the

EGGS OF THE HOUSE FLY.
(Magnified twelve diameters.)



SURFACE OF A FLY'S EYE SHOWING FACETS.
(Magnified.)

interesting fact that the closely set hairs on their under surfaces secrete the stickiness which secures the Fly's footing.

When a Fly is not busy dabbing something, most likely it is stroking its head, or cleaning its wings, or rubbing its "hands" or its "feet" briskly together. Its inquisitorial pursuits evidently necessitate a prodigious amount of personal cleansing, for which purpose the inner side of the middle portion of the leg, being densely hirsute, is used as a brush.

Recently, along with others, the domestic Fly was found guilty of spreading infection by transporting harmful microbes upon its hairs. It has also been accused of desultory biting, particularly during the autumn months; but investigation shows that the Flies frequenting houses are not invariably all true House Flies, however similar they may seem to be. Two which are often found indoors are *Homalomyia* and that market garden pest, the Cabbage Root Fly

FOOT OF FLY, SHOWING THE PYRIFORM PADS BENEATH THE CLAWS.

HEAD OF A TABANID MAGNIFIED TO SHOW THE TONGUE AND LANCETS.

(*Anthomyia*). These are miscalled "Small House Flies."

There is a third, the Storm Stomoxys, and this is the culprit whose wickedness has been charged against the unfortunate House Fly. It will be seen from the photograph that in size and in outward appearance the biting Stomoxys closely resembles the four House Flies in natural attitudes around it; but its trunk is very different—a rigid needle-piercing proboscis carried, as shown, projecting horizontally in front of the head when not in use. Its customary haunt is the pasture field, where it may often be noticed resting on the gates. Strangely enough, it has a habit of entering dwellings before the approach of a storm, leaving when the weather brightens. Stomoxys reminds one of the dreaded tropical Tsetse (*Glossina*). The inexpert might see no difference between them. Not entirely sanguinivorous, it is frequently found sucking up nectar from flowers.

AQUATIC LARVA OF A TABANID.

A giant of the race is the Horse Fly (*Tabanus bovinus*), a phlebotomist whose lancets can penetrate an ox hide. When flying, the vibration of its powerful wings produces a strong humming sound, terrifying to grazing animals. The females are the afflictors. The imperfect lancing apparatus of the males renders that sex incapable of blood-sucking. While the females are busy with the cattle in the meadows, the males are elsewhere engaged with the flowers. For the same reason the males of other biting Flies, with few exceptions, subsist on the juices of plants. This is true of *Hæmatopota*, the provoking Cleg, a lesser relative of the dun and bulky Horse Fly. In the hot sultry days it is scarcely possible to walk in the vicinity of woods without experiencing this paragon of viciousness. How silently she settles—no intimation of her presence until the first pungent prick! It is difficult to think of anything more exasperating, more productive of unseasonable temper, than the calmly insistent way in which these deliberate

THE CENTRE OBJECT IS STOMOXYS, THE OTHERS ARE HOUSE FLIES.

THE FOREST FLY (*HIPPOBOSCA EQUINA*).
(Four times the natural size.)

Clegs devote themselves to one's person. Myriads of these green-eyed termagants, but not a male among them !

The formidable nature of the Tabanid mouth instruments will be seen from the photograph on page 887. The lip and tongue combined forms the sucking proboscis, here placed close against the side of the head. The other spread-out parts are sharp stylets and cutting blades. When operating upon a victim, the Tabanid applies its proboscis firmly to the chosen spot and sucks up the blood from the wound made and widened by using together the stylets and blades.

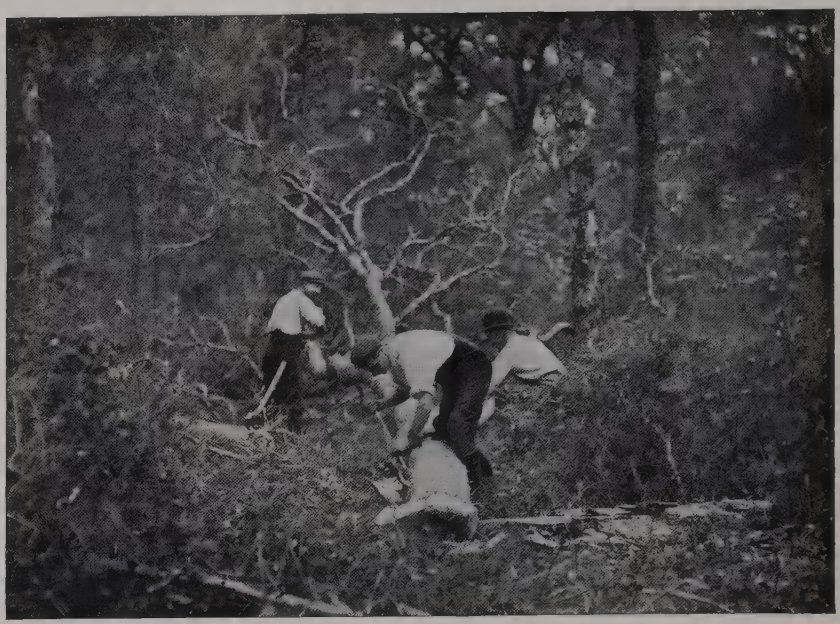
Tabanidæ deposit their dark-hued eggs upon grass or rushes in marshy places or by the water's edge. The maggots, or larvæ, are whitish and cylindrical, tapering at the ends, and with rings of fleshy protuberances encircling the body. Some are entirely aquatic, living among the mud of ditches or under stones in rapid flowing streams. They are carnivorous, devouring snails, worms, and water-beetle grubs.

"RAT-TAILED MAGGOT" OF THE DRONE FLY (*ERISTALIS*)
And first and second pupal stages.

Seeing a "rat-tailed maggot" brought forth from a stagnant puddle, anyone unacquainted with the strange vicissitudes of insect life might find it difficult to believe that so odd-looking a creature is in reality a Fly in making. It appears in early autumn as the Drone Fly (*Eristalis*), leisurely moving over sunflowers and thistles and flying suddenly from bloom to bloom. At a short distance it looks so like a hive bee in size, form, and colour that it may readily be mistaken for one.

R. A. STAIG.

THE HORSE FLY (*TABANUS BOVINUS*).
(Magnified half a diameter.)



STRIPPING THE BARK FROM AN OAK TREE IN THE NEW FOREST.

LIFE IN THE NEW FOREST—I

By F. MARTIN DUNCAN, F.R.P.S.

Illustrated with Photographs by the Author

THE New Forest! What recollections of feudal England its name brings to mind! Although called the New Forest, it is probably one of the oldest forests in England. Even to-day it holds many specimens of timber which date back beyond the time of the Roman Conquest.

The Forest embraces in its entirety considerably over 92,000 acres. Of this there are 62,746 acres over which one may wander without let or hindrance. Here and there, we may come upon a fenced area which is kept as a sanctuary and resting-place for some of the wild creatures, which but for these small reservations would inevitably disappear.

It is a great misfortune that the whole of the Forest is not appropriated as a national reservation for the protection of the many birds, beasts, insects and plants which are all too rapidly becoming extinct, thanks to the depredations of the professional collector. During the last few years the professional collectors who frequent the Forest, and make their living by collecting and selling caterpillars, butterflies, birds' eggs, etc., have increased in number and in activity; and it is inevitable that unless some measures are taken to put a stop to the present wholesale collecting of the rarer insects, plants and birds' eggs, the Forest will soon become denuded.

The wide area of the Forest presents such unique features of varying environment that nearly all creatures and plants to be found in Great Britain might make a home within its confines.

Passing through the Forest glades on a

late spring morning, the ringing sound of the axe falls upon one's ear, and a turn in the drive discloses one of the foresters busy lopping the branches of a recently felled tree.

One of the most picturesque Forest industries is that of felling the young oak trees in the spring, for the purpose, chiefly, of collecting the bark, which ultimately finds its way to the tanyards. It is looked forward to by the foresters with a good deal of pleasure, because it yields them a small extra royalty on their ordinary wages, and it is a pleasant sight to see with what a will the sturdy fellows engage in their work.

The moment the tree is felled to the ground some of the men set to work to lop off the branches, while others, with the aid of their barking irons, begin to strip the bark from the trunk and larger limbs.

While the barking is proceeding, one of the foresters may be seen rapidly constructing a frame with the smaller branches at a little distance from the tree; and against, and upon, this frame the bark is placed to dry. The length of this process is determined by climatic conditions, but if the spring be a genial one, the bark remains on the drying screens for about ten days.

When the bark is ready to be sent to the tanyards, the foresters go through the drives with their carts to collect it. The bark is gathered into bundles, and each bundle is weighed before being placed on the cart. When the carts have been filled they rumble away through the Forest glades to the nearest railway station, and from thence the bark finds its way all over England into those tanyards which make a speciality of oak bark tanning.

Towards the close of the summer, and during the autumn, the heavy lumbering waggons may be seen passing down the roads, laden with the trunks of the trees from which the bark had been stripped in the spring, on their way to the sawmills.

The people of the New Forest are a sturdy, self-reliant race ; the Saxon strain remaining strong in them, and one finds them still using old Saxon terms.

Curiously enough, although one would imagine such an environment as the New Forest, with its deep, silent woods and large tracts of lonely, marshy moorland,

WEIGHING AND CARTING THE OAK BARK.

an ideal one for the birth of folk lore, yet the Forest is singularly poor in legend.

Frequenting the Forest as I have for many years, photographing its inhabitants, human and otherwise, I have been unable to find anything of great remark in the nature of legend or superstition. I remember well on one occasion asking an ancient inhabitant if he had ever heard of any ghost story or legend connected with the Forest. After some little thought he replied, " He didn't think he had ever heard tell of any ghosts being seen about. He did remember that his grandfather used to go up on to Beaulieu Heath to look at the skeleton of a highwayman hanging in chains, in the skull of which some tomtits had built their nests."

A very remarkable character of the Forest passed away about three years ago in old Brusher Mills, who for many years had picked up a living as a snake catcher. At one time he made a fairly good living by this curious trade, supplying the Zoological Gardens and dealers with grass snakes and adders.

For many years he lived in a rude hut that he had built for himself in the Forest, and it was a very sore point with old Brusher that the verderers turned him out of his hut and destroyed it. It was a necessary act, however, because the old man had remained on the site so long that it was almost approaching the time when he could have claimed squatter's rights.

The Verderer's Court, in which all offences against the Forest laws are tried, is called the Court of Swain Mote; a name which, according to Manwood, is derived from the old Saxon word " mote," equivalent to the Norman " court," and the familiar " swain," or freeholder.

The foresters are permitted to turn out to graze in the Forest a certain number of ponies and cattle; they also have rights to cut turf which is used for fuel; and those foresters who hold the full commoner's rights are permitted to turn out their pigs in the legal " ovesting " or " pawnage " months, when the acorns and beech mast have fallen to the ground; that is, from about September 25th to November 22nd.

One of the most typical sights in the New Forest during the early summer is that of the half-wild ponies and their foals. During the daytime, in the summer, the ponies frequent the open land, where there is generally a gentle breeze blowing which helps to keep away the irritating flies, and it is a pretty sight to see the foals at play, chasing each other across the lawns and frolicking in the warm summer sunlight.

As evening approaches the mares whinny to their foals, and generally draw off towards the Forest glades, seeking shelter and warmth in the denser foliage during the night.

One of the most remarkable things about these ponies, to my mind, is their knowledge of the treacherous marshlands. Here and there, scattered over the Forest, we come upon areas of marshy, quaking bog, where one has to pick one's footsteps with considerable caution. The quaking bogs are areas of soft spongy land that tremble beneath your footsteps, and where you have to walk circumspectly, for a false step means an immersion in the bog, or possibly even one's total disappearance beneath the surface.

Now when wandering out across the bog-land studying and examining the plants peculiar to that environment, or observing the birds that frequent these lonely wastes, one remarks at once the tracks of the Forest ponies; and so long as one follows in their footsteps there is little fear of going through the surface of the bog to a greater depth than, perhaps, over one's ankles. It is wonderful the way in which these paths twist and turn through the bog; the ponies, apparently by some instinct, knowing exactly how far they may venture out on these treacherous, quaking lands. The result is that, unless driven frantic by fear, they travel across the bog-land without any mishap; and, indeed, it is a very rare occurrence for a Forest pony to founder in the marsh.

Returning home one evening through the Forest, I came upon a curious friendship existing between a hen and a cow belonging to one of the foresters. The cow was turned out of her byre every morning and wandered off into the Forest accompanied by this white hen. When the hen grew tired she would fly up on to the back of the cow and sit down comfortably and calmly and have a ride. I found that there was a good deal of give

and take really about this friendship, for when the cow grew weary in the noontide heat, and settled herself down for a quiet siesta, the hen would then mount guard and employ herself in picking off the flies that settled on the nose and round the eyes of the cow.

The naturalist in his rambles through the Forest will probably come, sooner or later, upon a gipsy encampment. There are still wandering in the Forest district two or three families of true gipsies, who speak the old Romany language, and who are true children of Nature, loving their outdoor life ; and having a keen knowledge of the birds and beasts around them, the naturalist photographer will often find the gipsies a considerable aid to him in his work.

Gipsies are suspicious of strangers, fearing alike the possibility of a police spy or someone connected with the educational authorities, and therefore it takes a little time to become on friendly terms with them ; but once the friendship is made, they are only too willing to help anyone who is really interested in nature, in the observation of the wild creatures of the Forest.

Unfortunately, there are within the boundaries of the Forest a number of would-be gipsies who have no right to that name ; they are mostly lazy, drunken, unclean tramps, too lazy to earn an honest living, content to shift from pillar to post, picking up a precarious living by what they may beg or steal ; and, unfortunately, it is from the depredations of these people that the true gipsy has gained a bad name.

FELLING A YOUNG OAK IN THE FOREST.

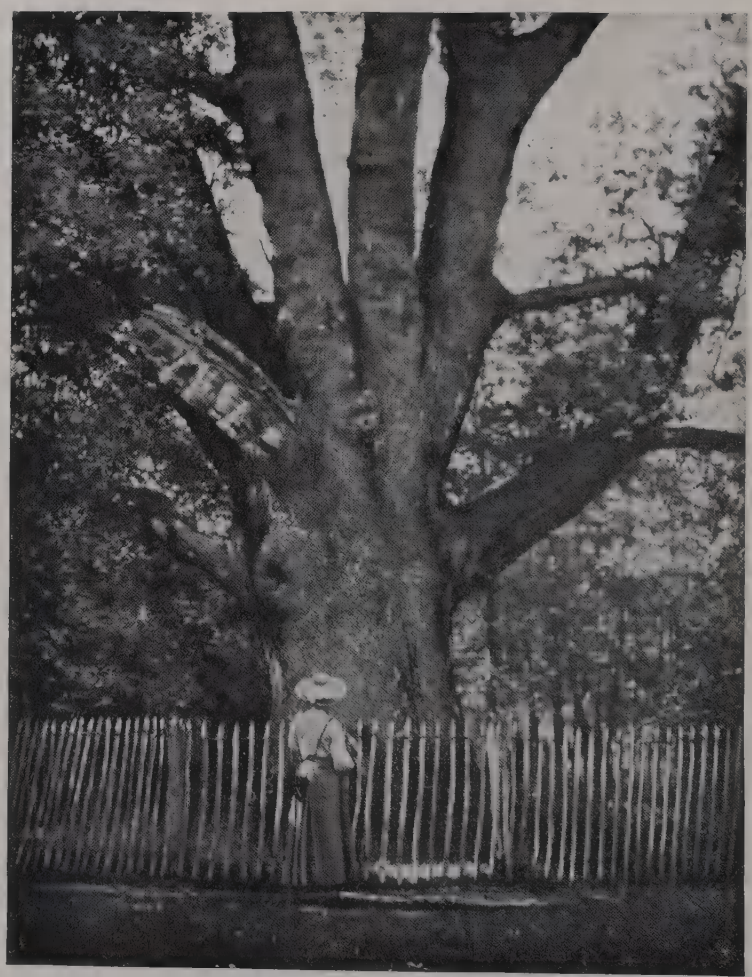
Amongst the gipsies one finds a certain amount of folk lore and legend relating to the Forest. They are a more romantic people than the Saxon inhabitants, and many a strange and weird story is recounted round the encampment fire at night.

To the lover of wild nature I know of no more delightful place to spend a holiday than the New Forest. In spite of the depredations of the professional collector, it still offers a unique ground for the observation of many of the rarer species of insects, birds, animals and plants.

Here one may see, if the season is a good one, the White Admiral butterfly actually in profusion. It is no uncommon sight on a warm summer's morning to see as many as fifteen or twenty of these magnificent butterflies flying over the opening blossoms of the honeysuckle and blackberry. How much longer they will remain plentiful it is difficult to say, unless public interest can be sufficiently awakened, and a strong demand be made for the more strict preservation of the Forest.

In the spring of the year the drives are beautiful with the blossom of the early orchid (*Orchis Mascula*), which depends for the transference of its pollen upon the visits of insects, and gains the benefit of cross-fertilisation through their agency.

An hour or two on a sunny spring morning may be spent with considerable profit to the lover of nature in watching the insects which visit the opening blossoms of this plant. The principal insect visitors, to these orchids growing in the Forest glades, will be found to be various species of bees, and it is a most interesting sight to see a bee alight upon the lip of an orchid flower and thrust its head inwards, in search of the drop of nectar which lies within the spur at the base of the sepals of the flower. As the bee thrusts her head inwards to suck the honey, she



AN ANCIENT MONARCH OF THE FOREST: THE KNIGHTWOOD OAK.

brings her forehead against the two little pollen masses which, if ready for transference, are very sticky at their base, and when she withdraws her head she carries them away. As she climbs up to the next flower, or round the spike, perhaps from one flower to another, we are able to see the two tiny pollen masses standing upon her forehead. The drying action of the air causes these pollen masses in a very few minutes to bend forward, so that when the bee alights upon another orchid flower and thrusts her head inwards to sip the nectar, the pollen masses have assumed such a position on the insect's head that they come into contact with the viscid surface of the stigma, and, in this way, the pollen is taken by the bee from one flower and transferred to the stigma of another.

HUMBLE-BEE VISITING EARLY ORCHID.

While watching and photographing the bees at work amongst the orchid blooms in a Forest drive, I observed a most interesting example of protective colouring. A bee had thrust its head into a flower and was busily engaged in sucking up the nectar, when suddenly something, that from a short distance looked like one of the unopened flower buds of the orchid, fell from the top of the flower spike upon the insect's back. The bee gave a shrill buzz of alarm and struggled to free itself from this apparent bud, which, in reality, was a spider. The foe was too strong, however, and having overcome the bee, carried it down to the base of the flower spike, and under the shelter of the drooping and half-withered blossoms, feasted upon the juices of its victim.

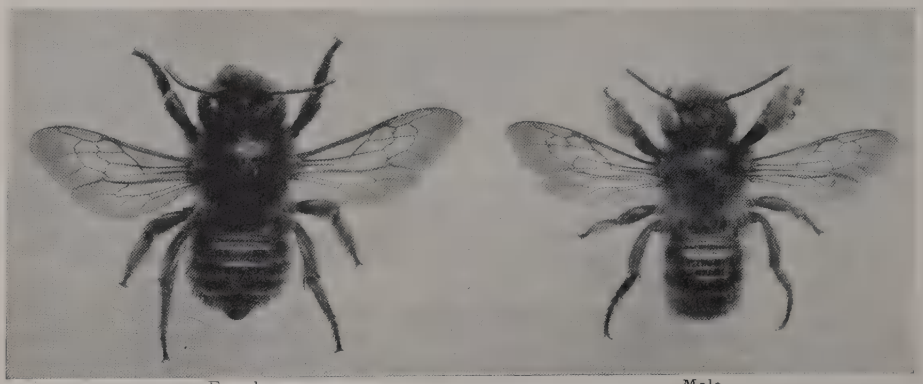
The spider having finished its meal, dropped the bee, and once more ascending the flower spike, tucked itself away amongst the round unopened buds, from which it was practically impossible to distinguish it, so closely did the shape of its body and its coloration resemble one of the unopened buds.

The lordly Purple Emperor butterfly is fairly common in the Forest, and may be seen flying over the topmost branches of the oak trees. Although such a magnificent insect, his tastes are somewhat plebeian, and his habit of frequenting the nearest pig-sty often leads him to disaster, for while engaged in feasting in this unsavoury spot he falls an easy victim to the ardent entomologist.

In late spring and early summer, as the dusk approaches, the trilling, sibilant note of the Mole Cricket sounds through the Forest glades, particularly where a rivulet flows by sandy banks, and if you watch carefully, you may see one of these curious insects come to the surface of the ground and perhaps take flight. The insect has gained its popular name partly from the subterranean life it leads, partly from a curious resemblance of its front pair of legs to the front legs of the mole. The muscular power of these short, broad legs of the Mole Cricket is very great, and it is a most interesting sight to see with what rapidity the insect burrows into the soil when alarmed.

One of the strangest insect inhabitants of the Forest is the caterpillar of the Lobster Moth (*Stauropis Fagi*). It lives, in July and August, on the beech, oak, alder, birch, hazel and lime, and has gained its popular name from the curious shape of the last two segments of its body, which somewhat resemble a lobster's claw. These caterpillars are nearly always to be met with singly, and seem to be of a curiously quarrelsome disposition, for should two meet upon a branch, a fight almost always ensues; while if two caterpillars be kept in the same cage in confinement, they will certainly fight and probably kill each other.

F. Martin Duncan.



Female. Male.

LEAF-CUTTING BEE (MAGNIFIED).

THE LEAF-CUTTING BEE

By HAROLD BASTIN

With Photographs by the Author

THE genus *Megachile* (Leaf-cutting Bees) comprises seven British species. All of them are specially interesting in their habits. One or two of the species are quite common, and the reader should have no difficulty in verifying the statements which I am about to make. The particular Leaf-cutting Bee shown in the accompanying photograph is called *Megachile willughbiella*. It often frequents gardens, both in the country as well as in London suburbs. In appearance it bears a distinct likeness to the Honey Bee, but is stouter and more thick-set. The male has its anterior foot-joints, or tarsi (excepting the terminal one), beset with a dense fringe of hairs—for what reason I have never been able to discover. But, as is the case with many other insects, the male Bee is a lazy fellow, whose habits call for no special remark.

Let us turn then to the female. She is larger, and considerably more robust than her partner ; and this is as it should be, for her life is passed in a round of arduous labour. Should you wish to discover whether the Leaf-cutting Bee is at work in your garden, you need only examine the leaves of the rose bushes. If any of these have cuts in them—some oblong, others almost circular—you may be sure that the insect is not far off, for the cuts in the leaves are her doing. She has been gathering material for cell-making. Come again to the rose bush during the morning hours, when the hot sun shines upon it, and you are almost certain to find the Bee busily engaged. Suddenly she alights upon a leaf, grasping with her legs the piece which she desires to cut away. Then, with her jaws she rapidly cuts the leaf-tissue ; and just as one imagines that she has bitten away the last shred of her support and will fall to the ground, she puts her shining wings in motion and darts off, carrying the severed piece of leaf safely gripped beneath her body. And whither does she go ? So rapid is her flight that it is difficult to follow its course with the eye. But by the exercise of a little patience, her destination may be discovered. This, when found, will prove to be a small tunnel leading to the interior of some decayed woodwork, such as a gatepost, or a beam in an outhouse or shed. For the reader must know that the Bee's

labours do not begin with leaf-cutting. She has, so to speak, several trades at her command, and at first she plays carpenter. Having found a beam or post a part of which is sufficiently decayed for her purpose, she drives a tunnel into it—rasping at the wood with her jaws, raking the chips beneath her body by means of her legs, and then, by walking backwards, pushing the débris out of the hole.

this piece rapidly—never, as far as I have seen, making mistakes. First of all the lozenge-shaped pieces are cut and carried one by one into the tunnel, and trodden into place until a thimble-shaped cell is formed. Then the Bee abandons leaf-cutting for a time, and resorts to the flowers, from which she gathers a supply of nectar and pollen. From these ingredients she compounds a sweet paste—

ROSE LEAVES CUT BY LEAF-CUTTING BEE.

The Leaf-cutting Bee will toil for days in her tunnel. At length, when she has made it long enough to suit her purpose, she abandons carpentering and begins to cut leaves. How she does this we have already seen. She uses the pieces of rose leaf to form cells, within each of which she deposits an egg and a supply of food for the young grub which will hatch in due course.

The pieces of leaf have to be of several shapes in order to build up the cell, but they may be roughly classified into lozenge-shaped pieces and circular pieces. The Bee's instinct seems to tell her exactly what pieces are needed when a certain stage of her work is reached, and she cuts ultimately more than half filling the cell with it. She then lays one egg in the cell. Finally, she again resorts to the rose bush and cuts some circular pieces of leaf, by means of which she closes the cell's entrance. When one cell is completed, the industrious Bee proceeds at once to form another, and so on until the tunnel is almost filled, the last inch or so being plugged with wood chips.

The number of leaf-fragments employed by the Bee in the formation of each cell varies somewhat with circumstances, but normally there are seven lozenge-shaped and four circular pieces. In the photograph on page 899 the reader may see the Bee side by side with its eleven pieces

of leaf, and may thus form some idea of the amount of labour compassed by the insect; but it should be remembered that to the labour of leaf-cutting must be added that of tunnelling and of gathering provisions for each cell as it is made. I do not think that it is possible to estimate the average number of cells formed by each Bee in the course of the season, for the reason that when one tunnel has been filled the insect may, and sometimes unquestionably does, make and fill another tunnel. I am convinced, however, that a score or more cells must often be made by a single Bee.

LEAF-CELL CUT OPEN TO SHOW HALF-GROWN BEE-GRUB FEEDING UPON HONEY WITHIN (MAGNIFIED).

A photograph reproduced on this page shows us part of a decayed beam (taken from a greenhouse) from which one side has been carefully removed, showing in section two of the Bee's tunnels with leaf-cells *in situ*. The egg in each cell hatches in a few days after it is laid, and the young grub begins at once to feed upon the good things provided for it by the instinctive labours of the mother Bee. Another photograph shows us a leaf-cell with part of its side removed, and the half-grown grub within, literally wallowing in syrup. It is a remarkable fact that the Bee mother puts just enough food into each cell, and no more; so that when the grub has licked up the last drop of syrup its appetite is satisfied. Thereafter it spins within its leaf-cell a cocoon of silk, coarse without but very fine within, and with a kind of cap at one end which—when the grub ultimately becomes a perfect Bee—is readily cut away.

A curious detail connected with the transformation of the Leaf-cutting Bee is that the grub, when it has finished its cocoon, does not at once become a pupa. In fact, it remains what it is throughout the whole winter, and only becomes a pupa in the springtime, a few weeks prior to its assumption of the imago condition.

Many solitary Bees pack their cells one after another into a tunnel bored in the ground or in rotten wood, and a moment's thought will show the reader that, should any of the insects at the end of this Indian file come to maturity before those which are nearer to the opening of the tunnel,

SECTION THROUGH ROTTEN BEAM, SHOWING TWO TUNNELS PACKED WITH LEAF-CELLS BY LEAF-CUTTING BEE.

they will be unable to effect their escape easily. The great French entomologist Fabre conducted experiments with certain of these Bees, in order to ascertain how they behaved in these circumstances. He found that if the imprisoned Bees could not cut or force their way between the cells in front of them and the side of the tunnel, they in no instance injured the cells themselves. Rather, they waited patiently until the way was cleared for them by the maturing and escape of their brothers and sisters in front. Whether the Leaf-cutting Bee is similarly patient, I am not yet able to state, though I know of no reason for suspecting it to be otherwise.

COCOON OF LEAF-CUTTING BEE, SHOWING NUMEROUS PUPÆ OF THE CHRYSID PARASITE WITHIN (MAGNIFIED).

The Leaf-cutting Bee has several enemies, one of which is a near relative. It is known as a "Cuckoo" Bee because its habits remind one of those of the cuckoo among birds. The mother Leaf-cutting Bee forms her cell, provisions it, and lays her egg. While she is away cutting the leaf-fragments with which to cap the cell, the Cuckoo Bee steals into the tunnel and lays one of her eggs side by side with that of the rightful owner. The usual result is that the Cuckoo grub devours most of the food, while the grub of the Leaf-cutting Bee pines and dies. There are also certain minute Wasp-like insects, belonging to the family *Chalcididæ*, which contrive to lay their eggs within the cocoon spun by the Leaf-cutting Bee grub. Exactly how they manage this I have not discovered, but they are very tiny, and so would be quite capable of forcing their way between the leaf-cells and the sides of the tunnel. Their egg-tubes, or ovipositors, would then enable them to pierce the wall of the cocoon. The tiny grubs of these Chalcid Wasps prey upon the big sleeping Bee grub, and ultimately devour it. Each is then transformed into a tiny pupa. I give a photograph of a Bee's cocoon with the side cut away. The whole interior is packed with Chalcid pupæ, while not a vestige of the rightful owner remains.

FEMALE LEAF-CUTTING BEE, WITH THE ELEVEN PIECES OF LEAF WHICH USUALLY GO TO THE MAKING UP OF A SINGLE CELL.

LATHRÆA SQUAMARIA (THE TOOTHWORT).
A species which is parasitic on Hazel roots.

CHAPTERS IN PLANT LIFE

III—THE PLANT AS A HOST

By S. LEONARD BASTIN

With Photographs by the Author

APART from the food and shelter provided by vegetation to animal life, one is not perhaps accustomed to think of the plant in its character as a host. Yet the question of entertaining guests enters largely into the existence of many species, and is a much more important matter than might at first be supposed. In considering the relations of the flower and the living agents which carry the pollen, we shall see how well the plant is able to reward those willing to render the required aid, but on the present occasion it is proposed to consider some far more intimate alliances. In some cases it is possible to show that the connections are of direct benefit to both the parties concerned—the plant providing housing, and even food, in return for services rendered. Other instances are more puzzling, in that although the plant does not appear to derive any advantages from its guests, yet it is willing to tolerate their presence, and even make some provision for their welfare. Finally, we find the plant as an unwilling host, with exacting visitors quartered upon it whose demands may be pushed to such an

extent that the very life of the host is at stake.

It has for long been realised that the relations between the plant and the ant present some remarkable points. The frequency with which these active insects are to be found in flowers cannot fail to have attracted the attention of observers. Now, in a certain way, the worker ants are not in the flower for any good purpose, having come to feast on the pollen and nectar. As these insects do not possess wings, they are not helpful in carrying the pollen from one plant to another, as bees and flies often do. Yet we cannot ignore the fact that in many cases the presence of ants in flowers is tolerated, if indeed it is not actually encouraged. As is well known, ants are peculiarly intolerant of the presence of other insects, and there seems no question that on occasion they will render ill-protected flowers a service in eating up other small marauders which come to plunder. It has been said, although the statement lacks confirmation, that ants will sometimes frighten bees away from flowers by the attacks which they make upon them. If this be so, the guests are certainly exceeding their duties in driving away the helpful bees.

Certain plants are seen to develop nectaries in other parts than the flowers. In the common Laurel these occur at the bases of the leaves on the under side. The Cherry, as well as other allied species, produces nectaries in the form of small glandular swellings on the leaf-stalks. In addition, it is found that the Broad Bean bears nectaries on its stipules. The actual purpose served by these processes has long been the subject of a great deal of speculation. Some have held that they must be regarded as curious protective devices. It is argued that creeping insects bent on plundering the store of good things to be found in the flower are turned aside from their nefarious purpose when they discover the glands secreting nectar. Here is a supply of honey easily secured, so why should the little creatures trouble to go on to the blossom at all ? In the case of the Scabrous Balsam, Kerner has observed that the drops of honey provided at the base of every leaf undoubtedly prevent a large number of wingless creatures from getting to the pollen. But it seems that the matter may be pushed to a still more interesting conclusion. These extra-floral nectaries will, of course, attract large numbers of ants, and the vigorous little creatures will certainly not allow any other visitors. Thus the numbers of small beetles and other insects which happen to be trespassing on the plant are dealt with very effectually.

YELLOW RATTLE, A PLANT WHICH IS PARTLY PARASITIC ON GRASS ROOTS.

The relations of plants and ants are known to be more definitely intimate than in any of the foregoing instances. As long ago as 1688 the old naturalist John Ray observed the frequent occurrence of ants in the hollow stems of *Cecropia palmata* and some other South American plants. It was not until the latter part of last century that an understanding of the matter was in any way complete. The actual observations were made in the case of the Bull's Horn Acacia. In this tree it was found that the hollow thorns were inhabited by ants, the insects making a hole for their entrance and exit near one of the thorns. In these little homes they rear their young, and Belt (in Nicaragua) declared that in the wet season every one of the thorns in the trees he examined was inhabited. If any browsing animal should attack the tree, the ants resent the in-

terference with great fury, rushing out to deal with the aggressor with jaws and stings. The services rendered to the Acacia go even beyond this.

AN ACACIA WITH SWELLINGS AT THE BASE OF THE THORNS, WHICH ARE INHABITED BY ANTS.

The South American forest trees are much subject to the onslaughts of leaf-cutting ants, whole armies of which will, at times, render a district almost denuded of foliage in a short while. The Acacias, which have enlisted the sympathies of the thorn-dwelling ants, are perfectly secure from attack. When the leaf-cutting species arrives on the scene it is to find the situation already occupied by hordes of ants fired by the enthusiasm which the defence of a home will always inspire. It is interesting to note the manner in which the ants are encouraged to take up their residence in the thorns. These when young are quite soft, and have their interiors filled with sweet edible pulp. As the insect eats away the contents of that which is to be its home, the thorn swells at the base and thus becomes more commodious. As well, at the bottom of each leaflet there is produced a small sweet gland, and in addition a tiny yellow food body at the end of each division of the leaf. So that it will be seen that the tree makes handsome provision for its army of defenders. It is only during the wet season that such liberal arrangements are made for the welfare of the ants. As soon as the time for the sending out of young shoots is past the honey glands dry up, and, left without their food supply, the majority of the ants perish. A sufficient number, however, survive to carry on the race during the time of scarceness.

Recent investigation has shown that the story of this strange compact between the ant and the Acacia trees is not at all exaggerated.

LAUREL LEAVES SHOWING NECTARIES.

The same state of affairs has been observed in quite a number of trees. In the case of the hollow-stemmed Cecropias, it has been found that the specimens which had suffered from the attacks of leaf-cutting ants were for some reason or other without their body-guard. With the Cecropias the ants enter the stems by means of a little door which they always make at one spot on the stem where the tissue is very thin. Here also the plants are provided with a plenteous supply of food. Near the base of the leaf-stalks are to be found brown patches on which are a collection of oval bodies. These are highly nutritious, and are eaten greedily by the ants. It is certainly significant that, both in the case of the Cecropias and the Acacias, the food bodies are absent where the particular species is not inhabited by ants.

It must not be supposed that in all cases where ants and other small creatures are found to be associated with plants it is possible to make out a clear case of mutual help. The curious plant *Myrmecodia tuberosa*, from the Malay Archipelago, is a case in point. The species is altogether most singular in appearance, and consists of a tuberous growth spreading on the branches of old trees, from the upper part of which spring the fleshy stems bearing the foliage. Every part of the tuber is tenanted by small red ants of a very fierce habit, which rush out and defend their homes when any attack is made. Some years ago, certain observers declared that it was through the agency of the ants that the tuberous growth was formed. The story was seriously placed on record that the bites of the ants caused the

basal swelling, and also the formation of galleries in which the insects subsequently took up their abode; failing these attentions, it was declared that the vegetable invariably died. This has of recent years been entirely disproved, for it has been shown that specimens of *Myrmecodia* may be easily raised from seed and grown to a perfect development, even if ants are entirely excluded.

The Yucca plants are natives of America, and when the specimens are in flower a little moth, known as *Pronuba yuccasella*, may be seen flying round the blossoms. The females of this species spend most of their time in the blooms, where they make arrangements for a novel form of egg-laying. The moth starts with the rolling together of a ball of pollen. As soon as this is ready, it is carried off to another flower, where the insect lays an egg at the base of the pistil, by thrusting its ovipositor down through the soft tissue. This done, the moth mounts to the summit of the style and places the ball of pollen upon the stigmatic surface, thereby ensuring the fertilisation of the ovules. When the caterpillar hatches, it finds itself supplied with food material in the surrounding tissues; there the larva will remain until the ripening of the seed, when it eats its way out, crawls to the ground, and then turns to a chrysalis under the surface.

As a general rule the numerous galls which are found so abundantly on the Oak, and also on certain other trees and plants, cannot be said to be harmful to the vegetable. Now and again, when the insects producing them become very abundant, growth may be stunted by the presence of the galls; or, as in the case of the dreaded Grape Louse of Southern Europe (*Phylloxera*), the plant perishes under the attacks which the minute creatures make upon it. Mostly, however, the plants seem to be neither better nor worse for having to develop the little houses in which the insects find a residence. Everyone must be familiar with the large round "gall nuts" which are found on the twigs of the Oak. Whilst

THE DODDER (*CUSCUTA EPITHYMUM*) ON HEATHER, A COMMON BRITISH PARASITE.

these are, of course, produced by the plant, the underlying cause of growth consists in the irritation set up by the minute gall wasps when the insects lay their eggs in the buds. These particular galls are but types of an immense number of examples exhibiting a wide range of form and size. Moreover, the life histories of the insects with which they are associated are in many cases imperfectly understood.

A very singular case of partnership between plants is that which is seen in the case of the Lichens. These used to be regarded as distinct individuals, capable of definite classification on the lines of other plants. It has been established that this is entirely a mistaken impression. Researches have shown that the Lichen is not a separate plant at all in the ordinary sense of the word. Rather must it be regarded as a case of that which has been called "symbiosis"—literally, the living together of two very distinct organisms. Every growth of Lichen must be thought of as a colony composed of thousands of individuals, in which, however, there is always one predominant. The chief partner of this strange alliance is a fungus, which encloses in its embrace a countless number of green Algæ.

In a certain sense it may be said that the fungus is parasitic upon these minute organisms, but only to the extent of stimulating the Algæ to great activity and vigorous increase. Both partners to the alliance appear to receive benefits from thus living together. Although at first this startling theory aroused an immense amount of opposition, there is no longer any doubt as to its correctness. The most convincing proof was that advanced by Stahl, who after some patient experiments at last succeeded in making Lichens by artificial methods. He took a well-known species of Algæ, and on this scattered the spores of a fungus. The result of this union was a Lichen in the form of a well-recognised growth. Again, it is possible to take any of the so-called species of Lichen, and start the constituents of the double organism on a separate existence. It is then seen that the little cells of the Algæ flourish and multiply, whilst the fungoid element of the union as surely starves. Now and again it is found that a lichenous growth of one type may embrace several distinct species of Algæ—familiar examples which are well known apart from this strange alliance.

A little-understood union is that to be seen in the case of Beeches, Birches, and some other trees. Here it is seen that the root tips are infested with a network of fungus threads. It has been suggested, although not actually proved, that the threads act as a kind of sponge between the roots and the soil, possibly taking some part in the transmission of moisture. In some instances it is known that the fungus threads really penetrate the substance of the roots, but it does not appear that any harm results.

In the tropical forests the branches of the trees offer resting-places for a host of plants. These species are entirely isolated from the ground, and were at one time regarded as parasitic in habit, but such is not the case. They lead quite independent existences, carrying out the elaboration of their chlorophyll in the ordinary way. For their moisture and mineral matters these perched plants rely upon rain and the atmospheric dampness which is such a feature of the steamy jungles. It is interesting to note that the roots of most Epiphytes are specially adapted for absorbing moisture from the air, the skin being of a peculiarly spongy nature. There is little doubt that in many cases the débris composed of rotting leaves, which collects in the forks of the branches, forms a good rooting medium. A large group of plants in tropical America is formed by the many species of Tillandsia.

One of the most curious of these, known as "Spaniard's Beard" (*T. usneoides*), offers an example of a conspicuous and widely distributed Epiphyte. This species has no real roots, but drapes itself round the branches of its host by means of its long thread-like stems of a silver-grey colour. A good proof that the Tillandsias are not in the least dependent upon soil is to be seen in the case of another species of Tillandsia at Kew. This example, which comes from Trinidad, has been suspended from the roof of a greenhouse for a long time. The roots of the specimen are simply in the warm, damp atmosphere of

THE STORY OF THE YUCCA.

the hot-house, yet the plant thrives perfectly well. The great Aroids of the genus Philodendron, and the strange Monsteras, perch high in the branches of trees, whence they send down long aerial roots. Although a great deal of moisture is absorbed from the air by these processes, they not infrequently find a final resting place in the damp soil beneath. As is well known, a large number of tropical Orchids are epiphytical in habit, and by their gay flowers adorn the branches of the forest trees with loveliness.

The plant is called upon to provide accommodation for many of its own kind, but it is to be feared that in a large number of cases the guest is not a welcome visitor. Quite often the host does not suffer greatly from the attentions which are pressed upon it. The mildly parasitic Mistletoe does not appear to be a great drain on the resources of the trees upon which it grows. The plant selects a wide range of hosts, embracing nearly all kinds of the common deciduous trees. In Britain, at any rate, the Mistletoe is chiefly found on the Black Poplar. The manner in which the parasite is distributed is very interesting. In winter the white berries are largely eaten by birds, and a certain number of the seeds will be likely to adhere to their beaks. To get rid of the encumbrance, the bird cleans his bill by rubbing it backwards and forwards on the bark of a branch. In this way the seed is placed in the best possible position for its purpose. As the seed germinates, roots are sent down into the tissue of the branch on which it rests, and the Mistletoe becomes quickly established. We may see from the leaves of the plant that it is not a very depraved parasite, the pale green foliage indicating that the elaboration of chlorophyll is carried on to a certain extent.

The story of the Dodder, a parasite of the most abandoned description, is a very different one from that of the Mistletoe. These remarkable plants, of which there are several species found in Great Britain, have given up all attempts to make a living for themselves in the proper manner, and have appeared on the scene as undisguised robbers. The life history of a typical species (*Cuscuta epithymum*) is most curious. The seed of the plant germinates in the soil in the usual manner of most plants. One fact which is significant is that, unlike most other flowering plants, the embryo of the Dodder is not provided with any reserve of food material. What little nourishment the developing plant requires, until it can enter upon its parasitical career, is drawn from the albuminous matter within itself. Soon after germination the thin radicle pushes its way down into the soil; meanwhile a red filament spreads upwards. It is a matter of urgency that the young Dodder should at the earliest possible moment be able to find a host, unless it is to perish miserably. The red shoot elongates at a considerable rate, and finally comes into contact with a suitable plant.

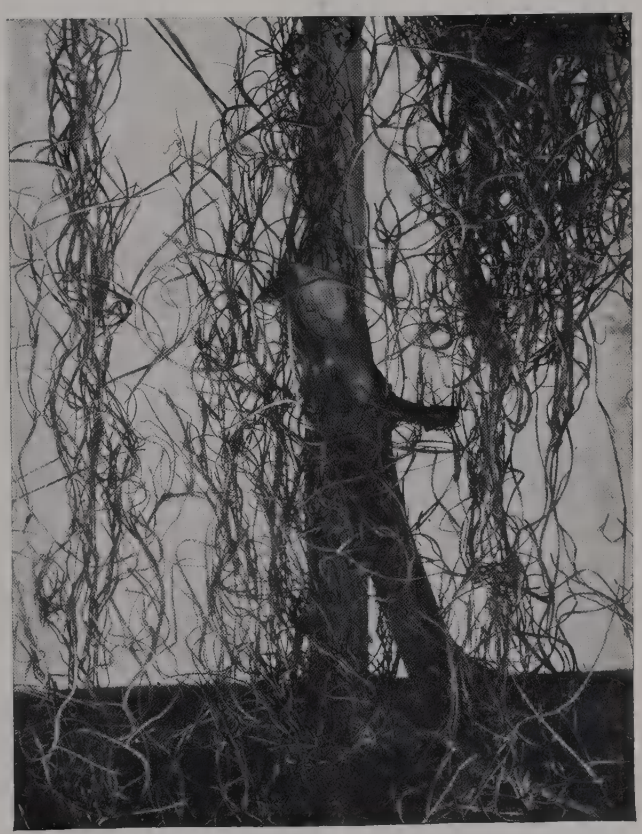
The particular species under consideration is very partial to furze and heather. At once the character of the plant is revealed; the root dries up, the harmless-looking threads produce suckers at the points of contact, and entwine themselves round the stems of the unfortunate plant selected as a victim. From thenceforward the red shoots of the Dodder increase at an incredible rate, thrusting out in all directions, and, wherever possible, affixing the suckers which drain away the life from the miserable host. About July, the Dodder develops its clusters of small white flowers, and soon afterwards the red filaments decrease in the vigour of their growth, and the parasite finally disappears. Quite often the plant which has been attacked is so miserably weakened that it perishes before the Dodder; but the activities of the parasite are such that it quickly transfers its operations to any adjoining specimen which may be suitable for its purpose. As showing what a formidable enemy the Dodder may be to the plant, even the hardy furze bushes not infrequently fall victims to the onslaughts of the parasite.

Of root parasites there are two very distinct groups—those which are only partially dependent upon their hosts, and those which can in no way support a separate existence. The common woodland plant, the Cow Wheat (*Melampyrum*), attaches itself by discs to the surrounding roots of its neighbours, yet this union

only occurs in the case of a proportion of the roots. The plant has, too, independent soil roots, and at the same time develops perfectly green leaves. In much the same way the Yellow Rattle (*Rhinanthus*) of our pastures attaches some of its roots to the underground runners of grass. Yet so green is the foliage, and so abundant the independent roots, that the plant can only draw to a small extent upon the resources of its host. These two species are only types of several hundred plants, existing in various parts of the world, which live partly at the expense of their hosts by means of root attachment.

There are few more curious plants than the Toothwort (*Lathraea*), a species which is wholly given over to parasitism. Owing to the courtesy of Mr. E. J. Allard, of Cambridge, the writer is able to give an illustration of the Toothwort. Though not common the plant has a wide distribution, being found on the roots of Poplar, Hazel, and other trees. The Toothwort is very easy to establish, and it may be seen growing in great abundance in several botanic gardens. The appearance of the plant is very singular, with its thick spikes of pale lilac-tinted flowers. Below the surface of the soil it is possible to see the manner in which the Toothwort gets a living. From the roots of the plant arise suckers—in one species (*L. clandestina*) as large as split peas—by means of which the roots of trees are penetrated. Another plant of similar habit to the Toothwort is the Broomrape (*Orobanche*), which grows as a parasite on the roots of many common plants, notably Broom and other leguminous species. The Broomrape has, of course, no true leaves, and looks more like a withered flower-spike, so dingy is the colouring of its inflorescence. There are several species of Orobanche to be found in Britain, one of which (*O. major*) is quite frequently to be met with. It does not seem that these root parasites are actually very harmful to the plants upon which they force their attentions.

One could not very well leave the subject of plant parasites without a reference to that wonder of the world, the *Rafflesia Arnoldi*. This species, which was discovered in Sumatra in 1818 by Dr. Arnold, is so curiously modified that it is almost reduced to one giant flower. The blossoms are of colossal proportions, measuring as much as three or four feet in diameter. The Rafflesia usually attaches itself to the roots of the trees which are close to the trunk, and presents a most striking appearance. The colouring of the enormous petals is of a lurid reddish brown shade, and the flower is said to attract large numbers of winged insects.



TILLANDSIA, OR "OLD MAN'S BEARD."

NEST OF WHITETHROAT.

SOME TYPES OF BIRDS' NESTS

By BENJAMIN HANLEY

Illustrated with Photographs by the Author

ON viewing a Chaffinch's neat, lichen-covered, cup-shaped nest, one is struck with its symmetrical outline and general beauty and possibly wonders why it is that all birds do not make their homesteads equally beautiful. Whilst some nests appear trim and neat, others seem to be the very essence of untidiness; but if one pauses to think, it will be seen that the fact of their being tidy or otherwise does not enter into the plan of the builders. Each is adapted for its owner's needs, and one and all are built for utility. Viewed in this natural light, all nests have equal beauty, and those special degrees of elegance which one at first admires are merely points of adaptation to its surroundings.

Take, for instance, the Chaffinch's nest. Why should the exterior be decorated with cobwebs and grey lichens? Simply to minimise the risk of detection. As often as not it is placed in the fork of a small tree either in gardens or woods, and the outside of the nest harmonising with its surroundings—*viz.* grey bark—it is easily overlooked.

The Lapwing, or Green Plover, merely collects a few straws and grasses; often even these are omitted, and the eggs laid on the bare ground. What use would an elaborate nest be to this bird? None whatever. It would simply lead to the discovery of its eggs, whereas the few grasses which it collects appear as but a handful of rubbish such as might easily be blown together by the wind; and where no materials are used there is even less danger, for the eggs agree so well with the bare soil.

The Kentish Plover, which lays its eggs amongst stones by the seashore, makes

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2

3

4

1. NEST OF BLACKBIRD.
3. NEST OF BLACKCAP WARBLER.

2. NEST OF WILLOW WREN.
4. NEST OF MOORHEN.

absolutely no nest, and yet its eggs are possibly more difficult to discover than those of any other bird. Imagine a stretch of beach several miles in length and of considerable width, covered with smooth pebbles, and one will readily understand that it is only by watching the birds one is able to find their eggs, otherwise the beach might be searched for weeks without result, the fact being that there is no nest to search for after all.

Gulls which nest on ledges of the cliffs make very little nest, only a kind of ring sufficient to prevent the eggs rolling off the ledge; but those which have forsaken the cliffs, and nest in inland marshes and tarns, build a more bulky nest of grasses and reeds, simply because it is essential that the eggs be kept clear of the water.

On the other hand, that of the Little Grebe, or Dabchick, which floats on the water, is a low pad of decayed vegetation, soaked with water, and the eggs, to all intents and purposes, one might say, are in the water also.

The Coot's homestead is usually a large, bulky structure; but even then until near at hand it looks more like a collection of reeds and rushes accidentally formed than a nest. This also applies in some cases to the lesser nest of the Moorhen.

Some nests are partially domed, like those of the Chiffchaff and Willow Wren, and as these are placed on the ground amongst vegetation they well answer their purpose. From above, if at all visible, the nest appears to be a lump of dried grass or hay, whereas were they simply open nests the risk of the light-coloured eggs being noticed would be all the greater. Again, the dome serves the additional purpose of shielding the eggs or young from moisture. After a shower, for instance, the vegetation around such nests is simply saturated with water, and but for the dome this would drip on to the contents of the nest.

Of course, birds have no reasoning powers; they simply build by instinct, and this sometimes plays them pranks.

The Common Wren's nest is usually well concealed, but recently I heard of one of these birds using a crevice in a brick wall and leaving long straws hanging from the nest, which could be seen from a great distance, and rendered it conspicuous. Why did the Wren make such a mistake? It was simply obeying instinct without reasoning. It was one of a brood reared from a nest built of straw in a hedge

NEST OF TURTLE DOVE.

1

2

3

4

1. NEST OF ROBIN.
3. NEST OF BLACK-HEADED GULL

2. NEST OF HEDGE SPARROW.
4. NEST OF LAPWING.

NEST OF PARTRIDGE—A FULL CLUTCH.

tangled with straw blown by the wind from a neighbouring stack. In that case the nest harmonised with its surroundings, but the following season the bird, using the handiest materials, secured a result calculated to lead to discovery rather than concealment.

The birds invariably use the handiest materials, and these usually conceal the nest; but, as I have shown, some odd times the very opposite occurs. I have found nests of the Wren built of hay pulled from the stack in the side of which it was built, and another in the side of an old willow tree formed of dead leaves picked up near by. This latter looked exactly as a collection of leaves blown together would do—and so both served their purpose.

Why should the nest of the Missel Thrush, in addition to being lined with mud, have a lining of fine hay or grasses, whilst that of the Song Thrush has only the first lining of mud and bits of rotten wood? Both need stiff mud sides to hold the heavy youngsters, but whilst the Missel Thrush builds in exposed situations, the Song Thrush usually places its nest behind a stump or other sheltered spot. With rain a simple mud lining would soon become soft, and without the inner lining of grass would bedaub the eggs or young. Thus we see the more exposed nest provides for this contingency.

For nesting in remarkable situations the Robin, without doubt, takes first place, building anywhere from an ivy-clad bank to the interior of an old kettle or tin. In our illustration the nest is amongst oak leaves in a wood, and when the bird was covering her treasures there was no perceptible difference between the colouring of the bird and the surrounding leaves—a case of protective resemblance.

Birds nesting in holes build a very loose nest, simply because the sides of the cavity prevent its falling apart, and it has to undergo no rough usage by the wind.

The majority of Warblers build a kind of swinging nest, a very slight structure indeed, slung between the stems of herbage or briar out of sight. Slight as these nests are, they are not damaged by the swaying of their supports; indeed, their very lightness proves their utility, for it gives elasticity, and these frail nests are the best that could be made for their surroundings.

Many more examples could be mentioned, but sufficient has been said to show that birds have probably no eye for beauty and no reasoning power, but simply build by instinct, from the handiest materials, a nest best suited to their purpose.

HAYMAKING.

From the Oil Painting by A. E. Bottomley.

THE BUTTERFLY OF THE OAK

By HAROLD BASTIN

With Photographs by the Author

THE *Lycænidæ* are a large family of small or moderate-sized butterflies which are distributed in all parts of the world. They may be roughly classified into three groups, which we may here designate by their popular names, to wit, the "Blues," the "Coppers" and the "Hairstreaks." Of these latter we have in Britain five species, two of which are rare. Superficially, all the species bear a considerable resemblance one to another, a characteristic feature being a more or less developed "tail" near the anal angle of the hind-wing, although this is not pronounced in the Green Hairstreak, which also differs from the other species in not possessing distinct whitish streaks on the underside of the wings. These butterflies agree with other members of their family in the possession of six perfect legs — a point, by the way, of considerable importance, seeing that in certain families of butterflies only four legs are sufficiently developed for walking.

The particular Hairstreak which is to form the subject of this article is, as my title indicates, especially associated with the oak. Indeed, of all the British butterflies it is the only one whose caterpillars feed exclusively upon the leaves of this

THECLA QUERCUS, NEWLY EMERGED (GREATLY MAGNIFIED).
Showing beautiful underside coloration.

THECLA QUERCUS CATERPILLAR.
(Magnified.)

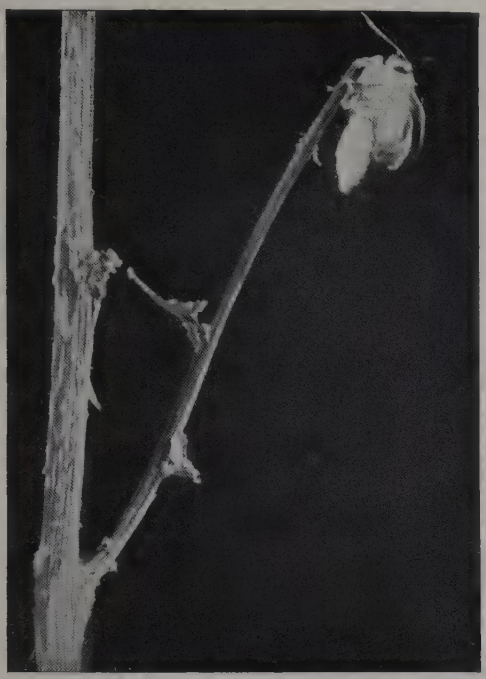
tree. Its scientific name is *Thecla quercus*, while it is known popularly as the Purple Hairstreak or the Oak Thecla. There is scarcely an oak wood in England, at least in the south, which is not graced in summer-time by the presence of this butterfly ; while it is well known in Ireland and in many parts of Scotland.

Beside being the commonest member of its genus, it is indisputably the most lovely. Let me briefly describe its charms. The outline of the wings is somewhat angular, owing to the costal and hind margins being nearly straight, while the tip, or apex, is only very slightly rounded. The outer margin of the hind-wing is slightly scalloped, and bears the little "tail" already referred to. The ground colour of the wings, on their upper surface, is brownish black, in the males overlaid, so to speak, with a rich purple gloss, save for a narrow area at the margins. In the female, this purple gloss is confined to a patch which occupies a portion only of each fore-wing ; but while abbreviated in its extent, the colour is more rich and deep, and reflects the light in a manner reminiscent of the Purple Emperor's glorious sheen.

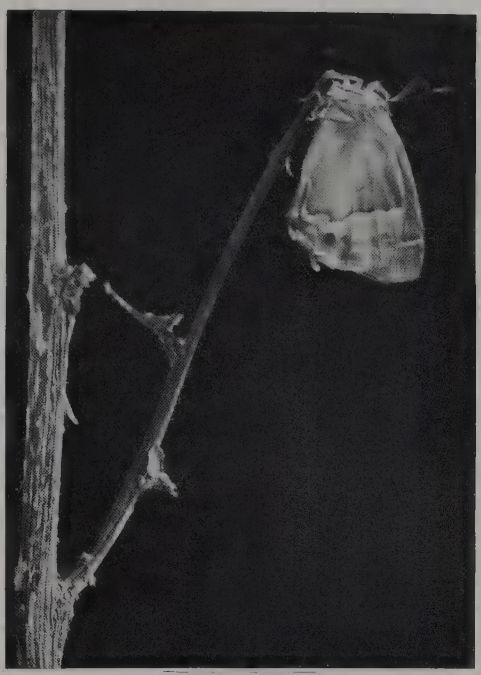
In both sexes, the under surface of the wings is a delicate ashen grey, inclining to pale brown in the males. Stretching across the wing-area is a white line, edged with brown, which, in the hind-wing, makes a kind of double twist, so that it assumes somewhat the form of the letter W. In the case of a rarer Hairstreak butterfly, this curious mark is so characteristic as to have suggested both the popular and the scientific names, to wit, the White Letter Hairstreak (*Thecla W-album*). The magnified photograph of the Purple Hairstreak Butterfly, newly emerged from the pupa, and hanging from a twig, gives some idea of the beautiful under surface of the wings and of their delicate marginal fringing. But a photograph fails altogether to suggest the exquisite softness of the colour scheme, or the two orange spots, one being black centred, which adorn the anal area of the hind-wing.

The Purple Hairstreak Butterfly is on the wing in July and August. In the former month the eggs are laid by the female on the twigs of the oak (*Quercus robur*). Here they remain throughout the winter, exposed to the inclemencies of

THECLA QUERCUS CATERPILLAR.
(Natural size.)



THE BUTTERFLY FRESH FROM THE PUPA.



THE WINGS HAVE DROPPED DOWN

the weather; but, as is the case with many other insects' eggs, they seem to be quite unharmed by cold or damp. In the spring-time, as the oak begins to put forth its leaves, the eggs hatch and the tiny caterpillars commence to feed. They are full grown in June—earlier or later in the month according to the state of the temperature in the spring, which may have hastened or retarded somewhat their hatching.

The full-grown Purple Hairstreak caterpillar is a quaint little object, and will repay examination by means of a magnifying lens. In common with the larvæ of *Lycænidæ* in general, it is short and hairy, somewhat like a woodlouse in shape, or perhaps even more like the familiar shell known as the Chiton. Its head is small and retractile, being drawn back into the first body segment when the creature is at rest. A caterpillar is shown, considerably magnified, in the photograph on page 914; and its resemblance to the Chiton shell upon a rock will be at

FEMALE *THECLA QUERCUS* READY TO FLY AWAY.

THECLA QUERCUS, MALE AND FEMALE FROM ABOVE AND BELOW.

once apparent to those who have experienced the delights of a collecting ramble on the seashore.

The colour of the caterpillar is brown, sometimes tinged slightly with green or pink. Its back is very convex, and down the middle there is a kind of groove, darker in colour. Down the back runs a chain of markings, somewhat arrow-shaped, and pale brownish or pinkish in colour. It is not always an easy matter to describe in words the appearance of an insect in such a way that the reader will be able to recognise it at sight. In this instance, however, I feel justified in comparing the caterpillar, and its colouring, with the crumpled bud-scales of the oak which, in June, still remain at the bases of the petioles of the leaves. I have been so much impressed by this resemblance on many occasions that I cannot help thinking it must be another instance of "protective colouring."

It is easy to imagine that a hungry bird, peering among the oak foliage, might mistake this caterpillar for a little bundle of dry and worthless bud-scales.

When it has finished its feeding, the Purple Hairstreak caterpillar assumes its pupal form. As the time for the change approaches, the insect loses most of its colour and becomes bloated and sluggish. After lying in this state for some hours, practically without stirring, it commences a series of rhythmic movements—the muscles of its body seeming to rise in waves from its head to its tail. By this means its skin is gradually worked backwards, in much the same way as one works a glove on to the fingers of one's hand. Eventually, the skin immediately behind the head splits, and the pupa begins to emerge. The rhythmic movements continue, and in a few seconds more the whole larval skin is completely worked off. At first the pupa is white, slightly tinged with pink, while it is about the same length as was the caterpillar. But it rapidly contracts, becoming ultimately stout and rounded. Its colour, too, soon darkens to deep reddish brown.

The foregoing remarks apply to the change from caterpillar to chrysalis as it takes place when the insect is in captivity, either upon the floor of the breeding cage or just beneath the surface of earth should this have been provided. For when in captivity this caterpillar does not spin any silk pad for its anal hooks, or fasten itself by means of a silk belt, after the common custom of its kind. Moreover, there is no doubt that the Purple Hairstreak caterpillar, even in its wild state, often pupates in the mould or moss at the foot of its tree trunk. But several authorities agree in stating that the pupa is normally suspended from an oak-leaf by the anal extremity and girded in the orthodox manner. The writer, however, has never yet been able to discover it in this position.

I have already said that the perfect

butterfly makes its appearance in July. The pupal skin breaks open at the destined moment, the captive creeps forth, and immediately ascends a neighbouring twig or grass blade—it matters not so long as the insect can secure a firm hold for its feet and a clear drop for its rapidly developing wings.

It is a fact that when the butterfly emerges from the chrysalis skin its every part is perfect, with the form and size of maturity, except the pad-like wings and the swollen and elongated abdomen wherein is contained the fluid which will ultimately flow into the wings. As soon as the butterfly has found a suitable spot, the afflux of this fluid causes the wings to grow very rapidly—so rapidly that in from five to ten minutes they attain their full size, although they are still wet, soft, and quite unfit for flight. An hour or more must elapse ere they become dry and firm.

THECLA QUERCUS CATERPILLAR ABOUT TO CHANGE TO PUPA (MAGNIFIED).

The rapid development of the newly emerged butterfly's wings is a marvellous spectacle, and calls for a word of explanation. It is brought about, as we have seen, by an afflux of fluid which is driven, chiefly by contraction of the abdominal muscles, from the body into the wings. The reader must know that the butterfly's wing is composed of two skins, or membranes, lying close together and supported by the veins. In the newly emerged insect the two membranes of the wing are corrugated—that is, each membrane is, so to speak, folded upon itself like a closed concertina. Thus, each wing is literally a bag which, as the fluid is forced into it from the body, would tend to expand like a balloon were it not that the membranes are held closely together by minute fibres or ligaments. As soon as the wings have dropped and expanded to their full size, the overplus of fluid is discharged from the butterfly's body, and the insect then remains hanging, quite motionless, until the wings attain their normal consistency and firmness. The Purple Hairstreak Butterfly is then complete. It usually climbs to a point of vantage, opens and closes its wings once or twice as if to test them, and then soars away into the sunshine. It delights to frolic with its companions in woodland glades and around the oak trees, often ascending to the topmost branches. It has a habit of selecting a special leaf as a point of vantage, to which, if disturbed, it will return time after time. In this respect it resembles the famous Purple Emperor (*Apatura iris*), which also selects a throne among the oak leaves. But although this regal butterfly in its perfect state is associated with the oak, its caterpillar must be looked for upon goat-willow or sallow bushes.

The Purple Hairstreak Butterfly has a wide range. It is common throughout Europe, except in the extreme north and south, while it is also found in Asia Minor. But in Europe *Thecla quercus* shares its distinction as the Butterfly of the Oak with another species, viz. *Thecla ilicis*. As its name implies, the latter insect is especially associated with the evergreen oak (*Quercus ilex*); but the larva—which is pale green marked with yellow spots and lines—feeds also upon the leaves of *Quercus robur*. This butterfly is dark brown. The anal angle of the hind-wings is marked with a small orange spot in both sexes; while the female has a large, dull orange blotch on each fore-wing. *Thecla ilicis* is found throughout Central and Southern Europe, North Africa and Western Asia. It abounds in every oak wood in Germany from May to July. That it does not range into England is a fact difficult to explain.

THE GIANT'S CAUSEWAY—ONE OF THE MOST WONDERFUL EXAMPLES OF NATURE'S MASONRY.

NATURE'S MASONRY

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author

IN all the seasons and throughout all ages Nature is for ever at work hewing and carving the face of the hills. She is indeed a mighty mason, and her tools are the rain and snow, the ice and frost, flowing stream, and beating waves. Nothing can be more delightful during our holiday rambles and country walks than to try and learn something about the ways in which Nature uses these tools.

During our annual visit to the sea we have an opportunity of observing how she utilises rain and frost and the storm-tossed waves in her masonry of the shore. A morning ramble along the shore from Bournemouth towards Poole will give us some insight into the way she carves the sand cliffs, using here for her principal tools rain and the inland springs. The sandy shore gently slopes upward from the laughing waters of a summer sea to the base of the brown cliffs, and as we look at them we see the rocks chiselled into buttresses and terraces, while here and there the face of the cliff is deeply scored. At the base of the cliff is a loose accumulation of fragments that have

slipped down its face during the progress of Nature sculpturing; this is carried away by the highest tides, but is constantly being replenished from above by the action of the springs, the wind and rain.

Ice is one of Nature's most powerful chisels wherewith she splits the hardest rocks. To see how this work is accomplished we must visit some high, exposed cliff on the mountain side after a night of frost. Perhaps the previous afternoon the clouds hung low upon the mountain, swathing it in a rolling mantle of grey mist, until every crack and cranny of the rocks was filled with water. As the night drew on, the temperature gradually fell lower and lower, until the moisture-laden rocks became coated with frost, and the rain that had accumulated in the crannies was converted into solid ice. Now these cold, dark hours have passed and the sun is shining gloriously, and as the frost and ice rapidly thaw, we begin to hear the tinkle of water, and ever and anon the sharp sound of falling stones, the chips falling from the work of Nature's chisel. To understand clearly how this ice chisel works we must comprehend what happened to the water as it slowly froze and thawed again. Water as it grows colder contracts in bulk until it falls to a temperature of about 4° C.; on reaching 0° C., the freezing point, it passes into the solid state, and at the moment of solidification suddenly expands; thus 91·75 cubic inches of water at 0° C. will pass suddenly into 100 cubic inches of solid ice. We can now better realise the tremendous splitting power of Nature's ice chisel upon the rock. During the night, the water imprisoned in the clefts of the rock, as it froze, suddenly expanded, and by the force of its expansion split out large and small fragments of rock, which, however, did not fall at once, but were held in position by the grip of the ice. Now the sun beats upon the exposed surface of the rocks, causing the ice to melt, and releasing the split masses of rock, which fall down to the base of the cliffs. In their descent these newly detached masses strike against the face

THE LAYER ABOVE EACH ZONE OF THESE COLUMNS REPRESENTS THE UPPER PORTION OF AN ANCIENT LAVA STREAM.

ONE OF NATURE'S TOWERS.

of the cliff, and dislodging other rocks that have been loosened by the action of the rain and ice, sweep them downwards. In this way immense blocks of stone are split and wedged outwards down the cliff.

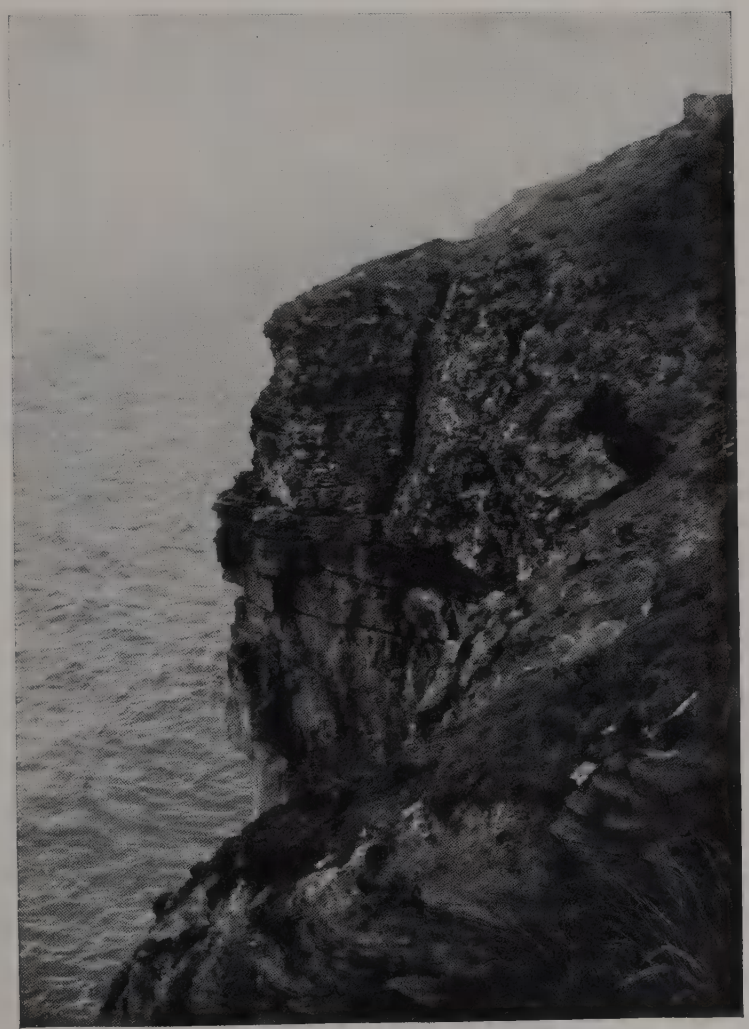
Rain is one of the most useful tools that Nature employs in her masonry, for in falling it dissolves and absorbs the gases of the air, and carrying these downwards exerts a powerful chemical action on the surface of the rocks. Those red-brown stains, so familiar in sandstone districts where the face of the cliff is exposed, tell of chemical decay, caused by the oxygen carried down by heavy rain making hydrated iron oxides as it percolates through the cracks and crannies. In the same way rain, taking up carbon dioxide from the atmosphere, attracts the limestone and forms pits and grooves in the surface of the cliffs.

A very remarkable example of Nature's masonry, chiefly formed by the action of rain and frost, is the Agglestone, or Haggerstone, which stands about 18 feet high upon a sandhill near Studland. It is an irregular weathered remnant of the Bagshot Sands, that owes its preservation to the induration of the sands, and forms a most striking feature of the landscape. It is only natural that this strangely shaped mass, standing out weird and isolated on the heather-clad plains, should

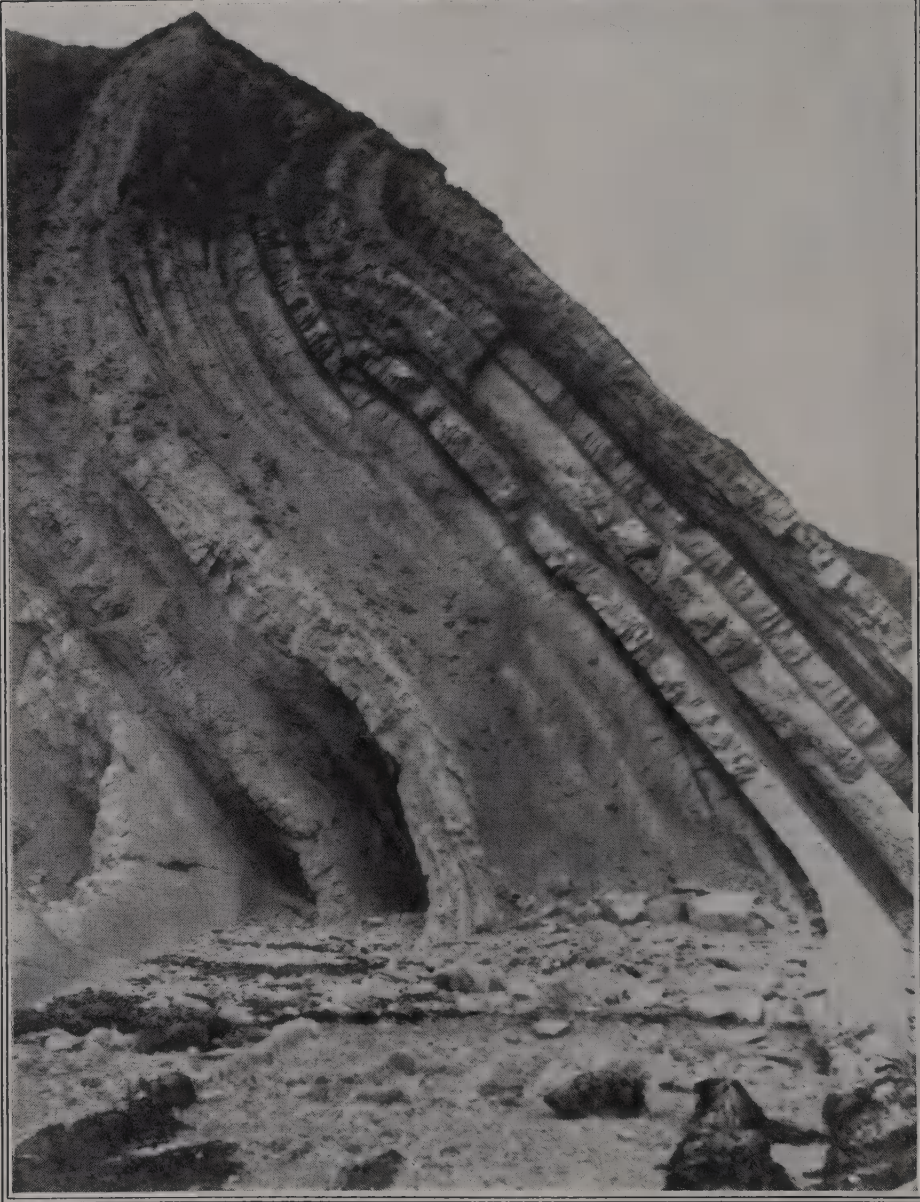
THE AGGLESTONE IS A GIGANTIC WEATHERED REMNANT OF THE BAGSHOT SANDS.

have stimulated the imaginations of our forefathers, and as a result the following quaint legend relating to the origin of the Agglestone has been handed down from monastic times. Tradition has it that when Salisbury Cathedral was in process of building, his Satanic Majesty was so enraged as he gazed upon it from the Isle of Wight, that he seized the Agglestone, and hurled it with all his force at the cathedral, hoping to obliterate it. But the Agglestone was miraculously arrested in its flight, and fell harmlessly upon the sandy hilltop at Studland.

The coast of the Isle of Purbeck affords many interesting examples of Nature's masonry. Passing down to the coast again, after our examination of the Agglestone, let us in imagination set sail towards Swanage. As we pass out of Studland Bay, the great chalk cliffs of Ballard Down tower above us, and just before coming to the famous geological Fault, where the strata are seen to have been thrust upwards, we pass one of Nature's towers that she has chiselled out of the cliff with her tools, the waves, and the wind and rain. In the afternoon, when the cliffs are partly in shadow, this tall, white, conical tower stands out from



IMMENSE BLOCKS OF STONE ARE SPLIT AND WEDGED OUTWARDS.



"THE CLIFFS ARE BENT AND FOLDED INTO GREAT SWEEPING CURVES."

DURDLE DOOR IS ONE OF THE MOST BEAUTIFUL NATURAL ARCHES.

the coast, a most striking and beautiful example of Nature's masonry. Sailing onward we arrive at Lulworth Cove, and here the scene is wonderfully impressive, for the strata of the cliffs are bent and folded into great sweeping curves. At first one would be inclined to imagine that this great contortion of the surface of the earth must have been produced before the rocks had solidified, or that it is the outcome of some violent volcanic upheaval, but really Nature has slowly produced these wonderful sweeping curves by immense pressure brought to bear upon the rocks when they were at a great depth.

Not far from Lulworth is Durdle Door, one of the most beautiful natural arches to be seen in the west of England.

Amongst the most wonderful and, when we come to consider the forces used in their moulding, most awe-inspiring examples of Nature's masonry, are the beautiful basaltic columns which have made Staffa and the Giant's Causeway famous. The north of Ireland offers unique opportunities not only for the observation of these basaltic columns, but also for gaining a clear insight into the history of our volcanoes which, in past geological ages, must have sent forth enormous lava streams over the country. As we pass in the train from Coleraine to Londonderry, the scenery is singularly grand and impressive. On our left tower the dark gloomy cliffs of basalt, telling of mighty volcanic energy in the past ages; while on our right are the recent sand-banks, and lovely blue, sun-kissed waters of Lough Foyle. If we tramp inland from the east coast right into the heart of County Londonderry, we shall find the surface of the country formed of gently swelling basaltic plateaux. There is an indescribable charm about the wild and almost desolate landscape, with its purple, heather-clad uplands and broad, nearly treeless levels of bog land. As we stand by one of the typical conical peat stacks, and gaze away across the warm, brown expanse of bog, to the distant purple of the gently swelling hills, over which great masses of cloud are passing in a glorious

HERE NATURE HAS USED RAIN AND LAND-SPRINGS AS HER TOOLS.

pageant of endless form and colour, we are enthralled with the quiet beauty of the scene spread out before us. When at last we turn reluctantly away to continue our tramp across country, we carry with us a mental picture of the charm of that wild landscape which will return to us again and again through the years to come. These gently swelling lava plateaux over which we tramp are relics of volcanic activity which took place in a past geological age, called the Tertiary Period.

If we explore the cliffs towards the Giant's Causeway, we shall be able to trace the double structure of these ancient lava streams. On the storm-swept face of these cliffs of black-brown, volcanic rock, almost every alternate layer shows in the form of graceful six-sided basaltic columns. The layer above each zone of these columns represents the upper and more irregular portion of the ancient lava stream, while here and there we shall see some massive flows which have escaped columnar division entirely. The Giant's Causeway is really the basal part of one of these lava streams, which we have seen in its entirety in the terraces of the cliff close by. As we look down upon the most worn portion of the Causeway, the surface presents the appearance of a titanic tessellated pavement, and we can easily understand how this wonderful example of Nature's masonry came by its name.

One cannot gaze upon those beautiful symmetrical columns, so uniform in shape, without marvelling at the forces which moulded them in the dim past of the Tertiary Period. Volcanic energy, great heat, and chilling air are the tools with which Nature has shaped these six-sided columns out of the lava streams; and wherever volcanic eruptions are taking place to-day, there these columns are being formed, just in the same way as those of the Giant's Causeway were formed in the lava flows of the Tertiary Period.

F. Martin Duncan.

"NOT HUNGRY, THANK YOU."

THE LONG-TAILED TIT

By A. J. R. ROBERTS, B.A.

Illustrated with Photographs by the Author

"CHURR, churr," in low, lover-like tones echoed a similar call, and a Long-tailed Tit—the daintiest ball of feathers imaginable—flew to rejoin its mate, paused to gather a tiny morsel of moss or lichen, and then passed on. "Churr, churr," called the second bird, as though afraid of losing touch even for a moment with its newly-found partner, and thus they flitted from branch to branch and tree to tree, unwittingly leading me into the sheltered valley which they had made their home.

A swift woodland brook, sparkling and singing in tiny rapids over a gravelly bed, silent and shadowy in the deeper swirling pools, caressed the foot now of one, now of the other of the twin hills that hemmed it in, as though unable to decide upon which to bestow its favours. On either bank the hills rose steeply, though to no great height, each well wooded, yet totally different in character. Facing east, an oak wood, bare as yet, carpeted with dead brown leaves, relieved here and there by a clump of primroses on long, slender stalks, seemed dark and mysterious by contrast to the sunny, smiling valley—a fitting haunt for the carrion crow, the hawk, and the owl which lived there and sallied forth to perform their deeds of darkness.

The other hill, flooded with the afternoon sunlight, was crowned by a coppice

of firs whose deep evergreen needles mingled with the tender shoots of larch, blushing with "rosy plumelets." A steep bank, ablaze with short-stemmed primroses, descended to the stream, throwing forward a spur as though to buttress it. The peninsula thus formed was a veritable tangle of woodland plants, and bramble and honeysuckle combined to guard the sanctuary for the small furred and feathered world that peopled it. Towering above the thicket, like forest trees above the jungle, rose a large clump of gorse, and it was to these bushes that the Long-tailed Tits brought the results of their foraging.

The nest had reached the cup-shaped stage, and the birds were engaged in heightening the walls preparatory to doming it over. The whole structure was beautifully woven, moss entwined with fine dry grasses, bound securely with spider's web, and adorned outside with lichens. As I watched, one of the old birds entered, disappearing from view except for an inch or two of tail; but even without that guide I could follow the bird's movements by the heavings of the walls of its house, as the tiny architect turned round and round, pressing its breast against the sides so as to ensure its perfect symmetry. Then craning its head and neck over the edge, it rearranged some rebellious piece, added the fragment it had brought, and finally hopped out to sit close by, preening its feathers, while its mate took its turn, churring from time to time in sheer joy of the sunshine and the careless honeymoon days before eight or nine hungry mouths appear to make the business of life a grim reality.

Then off they flew together on a fresh journey, perpetually calling to and answering each other, returning with their spoils after some three or four minutes' absence, working incessantly at their labour of love, yet adding such minute fragments that at the end of some three hours' watching I could see no perceptible increase. Yet there was an increase. The walls were heightened, and some few

THE FAVOURITE OF THE FAMILY.

days later the nest was domed over, leaving an entrance hole at the side near the top. The framework was complete, compact, and springy, with a strength and resistance one would hardly credit. Then came the task of house-furnishing, and now the birds flew into the fir wood, whence from time to time I heard the whirring of wings of the pheasant, and it

HIS TURN AT LAST.

was easy to picture the Tits gleaning the feathers discarded by that dandy in his morning toilet. They were plentiful, too, judging by the frequency of the comings and goings; and they had need to be, for the softest of eiderdowns is not more soft than the interior of a Long-tailed Tit's nest. It is said that a naturalist has counted two thousand feathers in the lining of a single nest, and to one who has watched the untiring industry of the builders the sight of a nest torn out by some wanton vandal hand is moving almost to tears.

Then the eggs are laid—eight, ten, or even more—delicate, white prisons, faintly spotted with red at the larger end, suffused with a flush of pink from the yolk, and each containing the wonderful germ of life. As incubation advances, the shells lose their transparency, becoming a dull white, yet doubly precious doubtless to the little mother. The early life of the tiny brood is less easy to picture, but it must resemble that of most other nestlings. Unable to count, the parent birds have to feed their young in the dark, and it must be that the strongest, as ever in Nature, get the lion's share. Thus it is that some are fledged and leave the nest days before the others—or can it be that incubation is begun before the full complement of eggs is laid? In any case, as the young ones grow the nest would be strained to bursting were the walls any less firmly built. And yet the old birds enter, must enter to attend to the sanitary requirements of the brood. The excrement of all young birds in cup-shaped or domed nests is encased in a filmy sack, a wonderful provision on Nature's part to enable the parent birds to keep all sweet and clean.

Bad weather and other causes prevented my obtaining pictures of the birds entering or leaving the nest, and it was obvious that the young were nearly ready to fly; for, as I watched them one evening, I noticed that they climbed to the opening to receive the food. The next morning was gloriously bright, and I quickly had my camera set up with a few sprays of honeysuckle twined around it to mitigate its awe-inspiring appearance. The birds, confiding and trustful by nature, had become quite accustomed to my presence owing to my frequent visits, and it was as unnecessary as it would have been useless to attempt to conceal myself. I had not long to wait before the Tits returned with succulent green caterpillars, and from the indescribable tremulous cries proceeding from the undergrowth it was apparent that they were feeding some young ones that had already flown. An hour passed swiftly without any serious attempt on the part of the parent birds to approach the nest, though they examined the camera and convinced themselves of its harmlessness. It was sufficiently entertaining to observe how perfectly they kept in touch with their scattered brood, invisible to me in the dense carpet of plants, and my ears and eyes were fully occupied in following the doings of the hundred and one other creatures abroad on that May morning. At last it occurred to me to wonder if *all* the brood had flown, and carefully feeling with one finger, I discovered that my camera was focused on the empty, deserted nursery.

"CAN'T PLEASE EVERYBODY."

The young ones could only have left the nest an hour or so before my arrival, for they were still far from proficient in the use of their legs. A careful search resulted in the capture of three fledgelings, which I placed on a spray of bramble, and readjusting the camera, I waited once more. Almost immediately the parents responded to the hungry appeals; but, hovering like humming-birds before a flower, they fed their young ones whilst on the wing. It was delightfully pretty to watch, but the light was not sufficiently

THE DESERTED NURSERY.

strong to permit of the rapid exposure which would have been necessary, so, transferring the fledgelings to a spray of honeysuckle, I arranged the bramble in such a way as to compel their parents to alight. It now occurred to one of the trio that he was wanted elsewhere, and, stretching his feeble wings in a venturesome flight, he paid the penalty of his rashness by falling into the stream. I was not aware that the old birds were in the neighbourhood at that moment; but nothing connected with the young seemed to escape their watchful eyes, and immediately they fluttered helplessly around, uttering cries of distress and alarm. It was the work of a moment to effect a rescue and replace the wanderer on the branch with his companions, but the incident had a lasting effect on the behaviour of the parent birds. From that moment they seemed to have absolutely no fear, and fed their young in perfect unconcern within four or five feet of me as I stood by my camera and obtained a series of pictures. The grace and charm of their movements were wonderful. No effort seemed to be needed as they circled around the tiniest twig, and the swing and balance of the tail imparted a finish to their gymnastic feats which is lacking in the other Tits. One is conscious of the extraordinary strength of the leg muscles whilst watching the Blue Tit or any of its relatives, but the Long-tailed Tit leaves only the impression of graceful ease, concealing his art with the masterly skill of the true artist.

There was no apparent method in the feeding of the trio, and the behaviour of the old birds was an interesting comment on the shortness of bird memory. Even with the three young ones arranged in a row, they seemed to have no idea which they had fed last, and popped the food into the beak which yawned the widest. Once indeed—the only occasion on which I have ever seen it happen—both birds forced caterpillars down the throat of one young one at the same time and, contrary to one's usual experience, my camera happened to be ready.

At last the fledgelings grew tired of their inactivity, and fluttering off into the undergrowth, they made their baby attempts to imitate the movements of their parents; and apt pupils indeed they proved, for on the next day they had gone forth into the world beyond their peninsula, and soon flitted in company through the woods, playing a kind of follow-my-leader—the traditional game of the species.

A. J. R. ROBERTS.

SAND-DUNES

By F. MARTIN DUNCAN, F.R.P.S.

With Illustrations by the Author

SHOULD we explore the whole of the coasts of Great Britain, one of the features that would most quickly and surely attract our attention would be the almost universal presence of sand, even where only a narrow strip of shore is left to view at low tide. In the course of our explorations, we should also find that wide expanses of sand flank the shores for miles along many parts of the coast, frequently on the land side forming into a belt of low hills or dunes, which in some situations rise to over one hundred feet in height.

If we scrape up a handful of sand from the shore and examine it, we shall find that it consists mainly of quartz grains, that are singularly uniform in size. "Where has it all come from? How has it been formed?" are questions that rise naturally in the mind, as we stand upon a wide expanse of sandy shore. The second is by far the easier question to answer, for the shore is the grindstone,

THE WIDE SWEEP OF A SANDY BAY.

and the waves are the power which Nature has used in the process of grinding down these countless sand grains. The granites, gneisses, and crystalline schists, wherever they form the coast-line, have contributed largely to the formation of the sands, though the denudation of the sea-cliffs under the action of the atmosphere, land-springs, and the waves cannot adequately account for the vast masses of sand to be found along our coasts. Probably a very large amount of the material, which in the course of geological ages Nature has converted into the golden sands that now fringe the sea coast, was originally transported shorewards from the hills and mountains by the glaciers and torrents of the Ice Age ; and during the succeeding ages the débris so transported has been broken down, sifted, and distributed as sand and shingle by the waves.

It is very interesting to observe the characteristic difference of form which exists between the sands of the sea-shore and the sands of the great inland deserts. The sand grains on the sea-shore will always be found to retain to a certain degree their angles ; and this characteristic peculiarity is due to the wet grains lying with their faces to one another holding a film of water between them, which keeps the grains from actually touching each other, and consequently greatly reduces the friction between the sides of the grains, which would otherwise wear down the angles. On the other hand, the sands of the desert are absolutely dry and destitute of this protecting film of water, consequently they are blown about by the wind, and beating against, and rolling over, each other, become rounded, and finally converted into dust.

On the confines of the Isle of Purbeck, from the entrance to Poole Harbour to Studland Bay, stretches a wide expanse of beautiful sands, where one may spend a long summer afternoon collecting the many rainbow-tinted shells that have been left exposed by the gently lapping waves of the receding tide, or wander along the sands at, and above, high-water mark where the sand-dunes are forming, and where every stage in the process of their formation may be seen.

The factors that play the most important part in the formation of the sand-

dunes are the configuration of the surface of the shore, the nature of the rocks along the coast, the set of the tide, and the direction of the most prevalent winds. Indeed, the prevailing wind plays a very important part, for if it be one that blows on-shore, it dries and blows the sand left exposed by the receding tide inland; while a prevailing off-shore wind will blow the sand back into the sea, and so prevent the formation of sand-dunes.

The sand-dunes generally form a kind of natural embankment, separating the comparatively low ground inland from the shore proper. Very often this low land, from which the sea has been gradually shut out by the development of the sand-dunes, forms at first a brackish lagoon which, owing to the growth of aquatic vegetation, gradually becomes converted into a marsh; and this marsh-land is in turn slowly raised by the growth and decay of the water plants, until it eventually becomes drained, and forms an area of land capable of growing and yielding a rich harvest of corn.

The shore and land between Poole and Studland afford an excellent opportunity for the observation of this most interesting process by which Dame Nature reclaims the land from the sea. During the spring tides, if we visit this stretch of the coast, we shall see a wide expanse of flat shore composed of beautiful firm sands. A soft, steady wind is blowing in-shore, and, helped by the hot rays of the sun, is rapidly drying the surface of the shore that has been left by the ebbing tide, and soon begins to drive the dried particles of sand landwards.

The shore slopes very gently upwards, and the drifting sand, as it is blown landwards, first passes over a perfectly smooth area up the slope until it comes to the inland margin of the shore, where the surface becomes more or less uneven, and is partially clothed by a scanty vegetation of sedges and grasses, and other plants. There, unless the wind is blowing a gale, the sand becomes heaped up amongst the stems of the grasses, and gradually, like drifting snow, fills up all the uneven depressions. Quite a superficial examination of many of the plants that grow along the inland sandy margin of the shore, comprising chiefly certain species of grasses, sedges, and the like, will reveal the fact that they are specially adapted

REEDS AND GRASS ARREST THE PROGRESS OF THE SAND.

THE SAND SILTS UP AMONGST THE GRASS STEMS.

to their environment, so that their roots mat and bind the sands together, and their stems are so shaped as to cause the sand to accumulate between them. Through the agency of these plants the drifting sands are arrested on their inland march, and, accumulating, become heaped up and formed into sand-dunes.

At the top of the shore the sand lies in low, loose mounds or hillocks, hardly worthy of the name of dunes, but as we follow them inland, they gradually increase in height, forming a series of miniature ranges of hills, each range running parallel with the shore, built up with graceful sloping curves seaward, and steeper and deeper valleys on the landward sides. The wind blowing the sand up the somewhat prolonged slopes on the seaward face of the dunes, tends to heap its burden at the top, from whence the higher currents of air seem to carry it partially across the valley that separates one range of dunes from another.

Inland, beyond this belt of sand-dunes, we come upon a narrow strip of heather-clad land which gently slopes downwards to the reed-bordered margin of a beautiful lagoon called the Little Sea. Standing on the summit of the highest range

THE SAND IS BLOWN UP THE GENTLE SLOPE OF THE SHORE.

of the sand-dunes at the hour of sunset, and looking landwards, the scene presented to our view is one of extraordinary and romantic beauty. At our feet lies the lagoon or Little Sea, its still waters reflecting all the glowing glory of the sunset sky. On its further margin the land slopes upwards into gently-swelling, heather-clad hills, which trend away into the purple distance where rise the beautiful Purbeck Hills. As the great ball of the sun slowly sinks in the west, the waters of the Little Sea take on a wondrous silver sheen, and as the first cool breath of the evening wind caresses our cheek, it brings the soft, sad, wailing cry of the wading birds. It seems as if we stood upon the margin of some enchanted lake, of such a lake as that to which the brave Sir Bedivere carried the dying king. Again, the wailing cry comes down the wind, and Tennyson's beautiful lines, instinct with life, rise to our lips :

" And on a sudden lo ! the level lake,
* * * * * *
Then saw they how there hove a dusky barge,
Dark as a funeral scarf from stem to stern,
Beneath them ; and descending they were ware
That all the decks were dense with stately forms
Black-stoled, black-hooded, like a dream—by these
Three Queens with crowns of gold—and from them rose
A cry that shiver'd to the tingling stars,
And, as it were one voice an agony
Of lamentation, like a wind, that shrills
All night in a waste land, where no one comes,
Or hath come, since the making of the world."

For a while a great silence seems to wrap us round, as the twilight deepens into dusk. A silence that fills the heart with a deep feeling of reverence, and of gratitude for the gift of life. We seem to draw nearer to Nature, and to better understand the marvel and beauty of her work, to dimly realise something of that mysterious all-pervading Power, which by the work of tide, wind, and vegetation, has during the march of centuries formed the barrier of the sand-dunes.

THE DUNES RISE HIGHER AND HIGHER.

As we turn homeward along the sands, the great silver disc of the moon rises and shines across the quiet bay now filled with—

" . . . such a tide as moving seems asleep,
Too full for sound and foam."

Silvery white stand out the sand-dunes against the deep blue of the evening sky, their miniature valleys filled with dim mysterious shadow.

F. Martin Duncan.

CHAPTERS IN PLANT LIFE

IV—THE PLANT AS A PARENT

By S. LEONARD BASTIN

With Photographs by the Author

THE first duty of the individual, and one even more important than the preservation of its own life, is the perpetuation of the race. It is easy to think of the care which the animal bestows on its offspring, the food and protection which the parent provides, the fostering of the new generation for its advent into a world of strife. We are not so prone to regard the plant as a parent, responsible for the reproduction and outfitting of its kind. Yet the members of the vegetable kingdom take many extraordinary precautions to ensure the well-being of their progeny, and the study of these forms a very fascinating chapter in the book of Nature.

In the present instance it is not proposed to enter into the wonders of the floral marriage, but to presume that the ovary has received the touch necessary for its development, and that the seed is an accomplished fact. Now a seed has never, perhaps, been better described than as a tiny plant wrapped up in a packet of food material. Cutting through the protecting skin of a bean, it is found that the seed easily splits up into two pieces. Between these two cotyledons, as they are called, we shall find the germ — a perfect little plant in which all the parts are plainly discernible, though on a diminutive scale. In the case of the bean, in common with many dicotyledonous plants, the supply of starch for the use of the young plant is absorbed into the cotyledons. The very large number of seeds possessed of only

one cotyledon carry the supply of food material in a separate store, which is spoken of as the albumen. The substance set aside for the nourishment of the seedling is sufficient to give the plant a good start until it is able to set up housekeeping on its own account.

The seed has been endowed with a marvellous vitality. If the conditions are not suitable for its development it can very well wait until the circumstances are more favourable. Thus, it is seen that the seeds which fall to the ground in the autumn do not, as a rule, germinate until the following spring or summer. Well authenticated instances are on record where seeds buried deeply in soil have remained in a state of suspended activity for many years. Finally, when digging operations have brought them more near the surface, they have readily germinated, apparently little the worse for their long confinement.

SEED OF THE ELM IS SURROUNDED BY A WING-LIKE EXPANSION.

Granted certain conditions, the seed will speedily show signs of development. Warmth, moisture, and the presence of oxygen soon stir the sleeping embryo into life, and bring about the wonderful changes connected with the birth of the plant. Heat is necessary for the forwarding of all vital processes; moisture is required for the conversion of the nutrient into a fluid state, whilst oxygen is necessary in order to bring about the change of the starch into sugar, in which form it can be assimilated by the plant. In a chemical sense, starch and sugar are not widely different, save that the former contains an additional proportion of carbon. The absorption of oxygen by the seed sets free the carbon, and thus changes the composition of the food supply. At first sight it may seem strange that in the beginning sugar was not stored away in the seed. It is a wise provision that has ordered it otherwise, for had sugar been deposited in the first instance it would almost certainly have undergone fermentation. In this condition it would, of course, have been useless for the nourishment of the little plant.

The most obvious change in the appearance of the seed when conditions favourable for its germination are present, is a decided increase in size. This goes on apace until the outer skin bursts, and two very distinct parts are to be seen. One, whitish in colour and sometimes branched, sinks at once into the soil—this is the root; the other, of a light green shade, rises above the ground—this is the shoot. In the germination of the seed we are witnessing a phenomenon which has provided the puzzle of the ages. What is it that induces the radicle with such persistence to plunge into the soil? However the seed may have been placed when it germinated, the root always wriggles round so as to strike

straight downward. Seeds which have been continually turned go through the strangest contortions in order that they may anchor themselves in the ground. It might be thought that it was the desire of the roots to get away from the light, had it not been shown that seeds grown in a box with holes in the bottom will send their radicles down through the openings out into the open. In doing so they leave not only the darkness behind them, but also the moisture in which they germinated.

It has been suggested, and with a good deal of reason, that the law of gravitation has not a little to do with this strange tendency on the part of plants. Years ago a president of the Royal Horticultural Society, Mr. J. A. Knight, germinated bean seeds on the rim of a vertical wheel, which was always kept revolving. Arrangements were also made to keep the seeds in a moist condition favourable to growth. It was found that the roots of the seedlings now grew outwards away from the centre of the wheel. From this it would appear that when the action of gravitation was overthrown by the centrifugal force of the revolving wheel the little plants were influenced by the new power. Thus it seems to be evident that the influence of gravitation in directing the course of the roots of seedlings is considerable. This does not by any means offer a complete solution of the problem; for whilst the root goes downwards the shoot with almost equal precision directs its growth upwards. It must be admitted that there is something more than a mere mechanical influence at work. We are indeed brought face to face with one of those mysteries which are as inscrutable as life itself. The most that can be said is that the radicle of the seedling is endowed with a geotropic tendency which impels it to bury itself in the earth, the tendency of the shoot meanwhile being in an opposite direction. As to the underlying causes of the happenings we are in complete ignorance.

Whilst the radicle of the seedling must always grow downwards, such is not the

THE SEEDS OF THE BULRUSH ARE CARRIED TO GREAT DISTANCES BY THE WIND.
It is computed that the head of the bulrush contains as many as a million seeds.

THE DANDELION IS TYPICAL OF THE FLYING SEEDS.

case with the secondary roots. These spread out laterally, and, indeed, can be induced to develop in an entirely opposite direction to that taken by the initial root. Thus, even if the radicle of the plant is injured in such a way that it cannot develop, the branch roots speedily come to the rescue. The seedling has indeed been endowed by Nature with extraordinary energy, and frail a thing as the little plant appears to be, it is not easily killed. Even if the plumule happens to be broken off altogether, this is speedily replaced by a fresh shoot, and the plant emerges on the scene but little the worse for the accident.

Throughout its life history the average plant is chained to one spot. It flowers, perhaps produces its seeds, without difficulty, and yet there still remains a problem which is by no means easy of solution. In certain circumstances the parent plant may be the greatest enemy of its own kind. The very fact of its continued existence after fruiting may form a serious menace to the well-being of its offspring. The seeds which fall on to the ground surrounding a perennial come up to find a well-established plant already in possession of the field—when their chance of arriving at maturity is exceedingly remote. There is no room for apprehension of this kind on behalf of annual plants, and it is curious that, generally speaking, the provisions for wide seed distribution of these species are not so pronounced as in the case of perennials. It is a very different matter with plants which live for more than a year, and many ingenious devices have been brought into being to ensure the scattering of the offspring over a wide area.

Some of the most beautiful arrangements to secure the passage of the seed are evidenced in those which are designed to be carried hither and thither by the wind. A vast number of seeds produced

THE RADICLE WILL TWIST IN A STRANGE MANNER WHEN THE SEED IS TURNED DURING GROWTH.

by the composite plants are contained in vessels provided with appendages to enable the processes to float away on the breezes. These devices reach their perfection in the various members of the Thistle family, which surround their seeds with the most perfect flying apparatus imaginable. Anyone who has watched a clump of Thistles on a breezy autumn day must have marvelled that the whole world has not long since been crowded out by these aggressive weeds. Every puff of wind raises the downy seeds from the plants, and away they go scudding over the country until they settle in some situation from which they cannot escape. The seed vessels of the Thistle often rise to a height of thirty feet in the air, and when at this elevation it is not unreasonable to suppose that they travel a mile or more before finally settling down.

Following after the Thistle there is a whole host of plants producing seed vessels which have tufts or crowns of hair as attachments. The pretty little parachute-like device of the Dandelion seed, the hairy tufts of the Willow Herb and Bulrush vessels, all materially assist in the dispersal of the plant's progeny over a wide area. A little plant, common enough in some meadows, known as *Thrincia hirta*, produces two kinds of seeds ; one is provided with hairy appendages, the other is not. The former are specially adapted for travelling over a considerable distance, whilst the latter are for the perpetuation of the species nearer home.

The seeds of many trees, although they cannot rival the length of flight accomplished by the Thistle, are by means of their formation wafted to a considerable distance. If the fruit of an Elm be examined a curious wing-like expansion is found, which when a moderate breeze is blowing enables the heavy seed to float away from its parent. In common with those of the Maple, the Sycamore seed vessels go round and round, and thus retard the rapidity of their fall to the ground. The golden long-stemmed blossoms of the Lime are developed with a green bract, and this appendage remains until the late summer. When the ripening of the seed has come about the whole process is detached from the tree, and as soon as it is in the air the use of the bract becomes apparent. The seed capsules are heavy, and pull the device into an upright position, in which state, as it falls, it commences to revolve with amazing rapidity. This induces a very leisurely fall, and, of course, all the while the process is sinking it is being carried farther afield by the breeze. The small seeds of the Birch and the Elm are surrounded by a membranous expansion which, as the vessels leave the tree, catches the wind and away they sail—not to settle down, perhaps, until they are some hundreds of yards away from the starting point.

Not a few plants rely upon water as the means by which their seeds are distributed. The strange double Coco Nut, the fruit of a Coco Palm, was a tremendous puzzle to early navigators, who very often found specimens floating in the sea many miles from the nearest land. The question was not definitely settled until the discovery of the Seychelle Islands, when the palm bearing the nuts was identified, thereby clearing up a great mystery. It is by ocean currents that the common Coco Nut has been distributed so widely among the Pacific islands. Almost the first tokens of vegetation on the coral reefs are the Palm trees, which appear on the smallest patch above high-water mark. The preparation of the Coco Nut for its long sea-voyage is a matter to which the plant has given special attention. In the first place the embryo and supply of food material are encased in a singularly dense shell, but outside of this is an enormous fibrous mass completely enveloping the nut itself. The distance over which these seeds will float is extraordinary, and were it not for the limited climatic range the species could not fail to have been established all over the world long ago. It is a well-known fact that seeds of various plants indigenous to the West Indies are not infrequently found on the north-west coast of Norway, where they have been swept round by a branch of the Gulf Stream.

In Britain the movements of water-borne seeds are to be observed in the case of many plants which grow on the banks of rivers or streams. The charming Snowflake, a plant which is probably not

a native, spreads amazingly by means of its seeds; these are encased in a capsule which readily floats. On the Loddon, a tributary of the Thames, the species has spread up and down the stream amazingly, and it is gradually extending to the main stream. As years go by it is likely that the Snowflake will become increasingly plentiful, until it is distributed throughout the Thames water-system. An astonishing illustration of the distribution of a plant by water is that afforded by the American water-weed *Elodea Canadensis*, a species which somehow was introduced into Britain about sixty years ago. In this short while it has managed to spread over most of the water-ways of Great Britain. Indeed, in many districts the plant has blocked canals to such an extent that it has proved a real hindrance to navigation.

THE SEED CASES OF THE MARTYNIA.

The number of seeds which are distributed by animal agency is immense. All kinds of devices are adopted to secure the conveyance of the seed from its parent to a distant situation where it will stand a reasonable chance of securing room for development. Those seeds having hooked vessels exhibit a variety of method which is amazing. Some, like the Martynias of America, are provided with hooks many inches in length; these seize hold of any passing animal as it plunges through the forest, becoming deeply embedded in the flesh, and the victim will perhaps travel several miles before it can divest itself of its painful burden. Even more formidable still is the seed vessel of the South African Grapple Plant (*Harpagophyton procumbens*). These roll about over the dry plains, and as they are provided with a large number of curved hooks, readily attach themselves to the coats of animals. Indeed, it is said that they have even been known to cause the death of lions. Finding some of the seeds attached to its skin, the animal endeavours to tear the cruel hooks away, with the result that it gets one of the vessels hopelessly entangled in its mouth, and so perishes in a most miserable fashion.

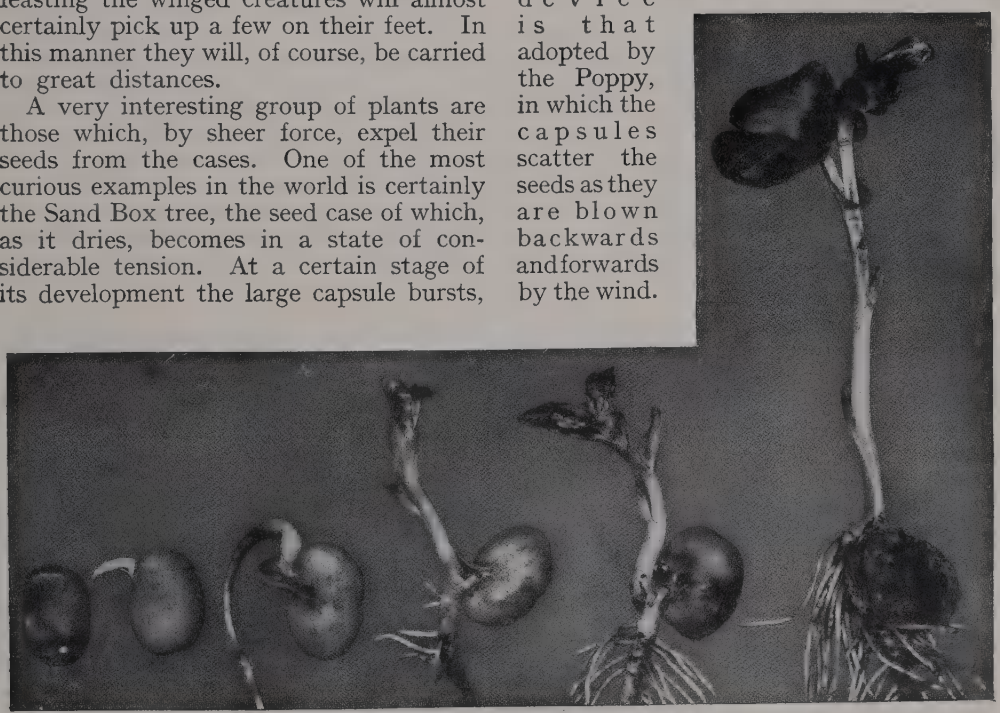
Many of our British plants produce seeds provided with hooks, although these are nothing like as formidable as the two foreign species described above. Indeed, the seed vessels of the Agrimony, the Cleavers, and the Burdock are really objects of great beauty. That the processes serve their purpose admirably is well known to anybody who has taken a walk in a field at seeding time. One's garments become quite thickly covered with the seeds, which hold on with great tenacity. From this it is easy to get an idea of the distance to which many of these may be carried whilst clinging to the coat of some wild creature.

A very large number of plants are able to surround their seeds with a pulp which is attractively flavoured. It is certainly

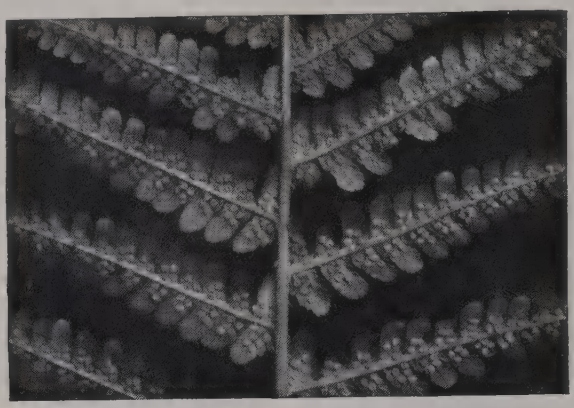
a curious fact that just at the time when the seeds are ready for dispersal the fruit or berry becomes a bright colour, as if the plant were anxious to attract attention to its progeny. In many of these cases the seed is protected by a hard covering that is quite unaffected by the digestive juices of any animal which should happen to swallow it when feasting on the fruit. It is not always that the seeds of fruits and berries are swallowed by the bird or animal acting as the distributing agent. It has been noticed elsewhere that the seeds of the Mistletoe are frequently carried about on the beaks of thrushes. Many of the seeds, such as Chestnuts, Beech-masts, Acorns, which are edible in themselves, are destroyed in large numbers by the animal life of the country. On the other hand, owing to their value as food, a large proportion of them will be carried to considerable distances by squirrels and other creatures, and perhaps dropped, or stored away and forgotten altogether. In a slightly different way enormous numbers of seeds which are eaten by birds rely for their dispersal on the fact that whilst feasting the winged creatures will almost certainly pick up a few on their feet. In this manner they will, of course, be carried to great distances.

A very interesting group of plants are those which, by sheer force, expel their seeds from the cases. One of the most curious examples in the world is certainly the Sand Box tree, the seed case of which, as it dries, becomes in a state of considerable tension. At a certain stage of its development the large capsule bursts, hurling the hard seeds with great force in all directions. It is said that passers-by have not infrequently been injured by the flying seeds. In much the same way the Para Rubber tree scatters its seeds afar, and when these are ripening in a plantation the sound resembles the constant firing of pistols. To come to more homely instances, the common Balsams of our gardens possess seed vessels which are veritable popguns. When the seeds are ripe for ejectment the five divisions of the capsule burst open and throw out the contents with a good deal of violence. The pretty little English Wood Sorrel offers another example of those plants which scatter their seeds with force. As soon as the seeds are ready for dispersion the capsule splits open, and the strong tense tissue covering the seeds being suddenly ruptured, throws them to a considerable distance.

Not a few of the pod-bearing plants contrive to have their seeds scattered afar by means of their legumes, which, when dry, curl up in spiral fashion and so eject their contents. A very simple device is that adopted by the Poppy, in which the capsules scatter the seeds as they are blown backwards andforwards by the wind.



THE NORMAL DEVELOPMENT OF A BEAN.
The shoot goes up and the root goes down.



PATCHES OF SPORANGIA ON BACK OF MALE FERN.

Even with this arrangement the distribution covers a much wider area than might be thought possible. A strange form of seed dispersion is that to be seen in the case of the Earth Nut (*Arachis hypogæa*). The singular part about this plant is that, as the seeds begin to ripen, the pods are forced below the surface of the soil through the lengthening of the flower stalks, and are in this way actually planted. The same method has been adopted by the Sweet Violet, and also in the case of a few other plants. The phenomenon is certainly rather a puzzling one, for the behaviour of these species can scarcely be said to aid in the wide dispersal of the plant. In some of the instances which possess this strange habit, there are, in addition to the subterranean pods, aerial ones which bear their seeds in a more ordinary manner. We may suppose that the seeds which are so carefully sown by the plant are put into position in order to make quite certain that the species shall continue to hold its own on that particular spot.

The large number of plants which do not produce flowers make comparatively little provision for the welfare of their offspring. The early observers were much puzzled as to how it was that Ferns which appeared never to produce seed were able to increase their kind. It was not until the coming of the microscope that the strange life history of the Fern was understood. An examination of the brown patches to be found on the back of many Fern fronds shows them to be groupings of strange little stalked cases, called sporangia. At a certain stage in their existence these sporangia burst open, and scatter their contents to the winds of heaven. This matter is formed of numbers of individual grains, in form varying largely in the different species. These spores are very different in their formation from the seeds of flowering species ; each one is little more than a speck of life in an elementary form.

Although the process of development from the spore to the Fern plant varies considerably, a typical case may be briefly outlined. Being very light, the spores float away on the slightest breezes and a certain number of them are sure to find a resting-place on some moist patch of soil. It is not very long after the lodgment of a spore that a change takes place, which by a process of cell extension results in the production of a heart-shaped green film in measurement about an eighth of an inch. After an interval, two very distinct kinds of cells begin to put in an appearance upon the under-side of the prothallium. These represent respectively the archegonia, or germ cell, and the antheridia, or sperm cell. At a certain stage in the history of these cells, thread-like processes, known as antherozoids, emerge from the sperm cells and enter the germ cells, and thus bring about the fertilisation of the embryo. Soon after this has been accomplished the prothallium and all its system of cells dries up, leaving behind only the fecundated germ. Yet another change, and the tiny frond struggles upwards, and the birth of the Fern is an accomplished fact.

THE TEASEL

By BENJAMIN HANLEY

With Photographs by the Author

WHEN seen in full flower the Wild Teasel (*Dipsacus sylvestris*) is a striking plant. It grows to a height of six feet or more, and the larger flower heads will measure as much as four inches in length. The flowers, mauve coloured, prove a great attraction for bees ; indeed, there is an old Yorkshire saying which likens a crowd of people to " bees round a Teasel (or ' Tazzle ') field."

The flowers commence to open out—not, as might be expected, at the base of the head, but half-way up, and then proceed in two distinct circles, one upward, the other downward.

The Fuller's Teasel (*Dipsacus fullonum*), formerly largely used in cloth dressing, was derived from the Wild Teasel. The photographs here given show the difference between the two flower heads. The bracts which remain after the flowers die are straight in the wild plant, and not very stiff ; but in the cultivated variety these are hooked and possess just the stiffness requisite for raising the nap of cloth without tearing it, and so large tracts of land were given over to the Teasel-growing industry.

The seeds, which are about a quarter of an inch in length, and very narrow, were sown broadcast in March or April, and the plants did not reach maturity until after a period of eighteen months. When fairly above ground the young plants underwent a process of " slinging "—*i.e.* the best plants were left growing about a foot apart and the rest rooted up along with weeds and rubbish. For this singling out a specially made spade was used, the blade being about eighteen inches in length and four or five in width, with a wooden handle curved outward so as to be well clear of the plants when in use.

May or June the following year the plants began to flower. The leaves are united at the base and form a kind of cup, which is nearly always filled with water, whether there has been any recent rain or no, the cup so formed by the two lowest leaves often holding considerably over a pint of liquid. If the rain had been recent this was often utilised by the hardy sons of the soil to quench their thirst.

In September, or nearly eighteen months after being sown, cutting operations began, sometimes the " hands " being engaged by the day at a stated wage and

DRIED FLOWER HEAD OF FULLER'S TEASEL (*DIPSACUS FULLONUM*).

DRIED FLOWER HEAD OF WILD TEASEL
(*DIPSACUS SYLVESTRIS*).

at other times by piecework, the latter being by far the more profitable to an experienced cutter. The flower-heads were cut off about eight inches from the top, and the upmost heads, known as "kings," presumably on account of their superior size, were made up into bunches of forty; the next in size, termed "maidens," and the least of all, "buttons," being tied into bundles of fifty.

It is said that an experienced worker could cut as many as twenty thousand per day. The rate of pay was threepence per thousand.

When engaged in cutting, the operators wore a kind of waterproof smock to save their clothing from being drenched by the water collected at the base of the leaves and the sticky sap which exuded from the cut stalks. When finishing work this overall looked as if it had been given a coating of glue.

As the stalks are somewhat prickly leather gloves were worn to protect the hands, and the cutting operation itself was performed by the aid of a knife specially made for the work, the blade being two to three inches in length, slightly tapering, and somewhat turned up at the point.

As the heads were made into bundles, they were hung on the old plants to dry for two or three days, and then strung on to long poles and carried to open sheds or "helms" erected in the fields for the purpose, there to undergo a further period of drying, which occupied several weeks. This at length completed, the bundles of heads were fastened round staves about three feet long by the aid of willow saplings, until they looked something like a circular brush. This done, they were despatched to the mills.

Any flower heads found blooming during the cutting season were termed "widows," and as the bracts were soft they were left on the plants, to be afterwards cut down along with the stubble, gathered into heaps, and burnt.

The demand for Teasel heads for cloth dressing is not now very extensive, and therefore the cultivation of this plant has gradually diminished year by year until now one cannot find many acres where formerly most of the land in the district was utilised. It is without doubt a dying industry; nevertheless, as one travels up and down the country, old sheds may be noticed which formerly were used for drying heads, the sides being composed of Teasel stalks tied together in faggots; and in most villages one may enjoy hearing related by some old worthy many interesting features and incidents connected with the cutting of the "Tazzle." From such an one the facts here given were elicited.

BENJAMIN HANLEY.

SUNLIGHT AND SHADOW.

From the Oil Painting by George Fredericks.

A WINDING STREAM IN THE NEW FOREST.

LIFE IN THE NEW FOREST—II

By F. MARTIN DUNCAN, F.R.P.S.

Illustrated with Photographs by the Author

ALTHOUGH the New Forest is probably better known to the entomologist than to the lover of bird life, the birds of the Forest are very numerous and interesting, for out of the 354 species which are natives or visitors to England, nearly 200 frequent the Forest. From April to July a glad and ever-increasing flood of song resounds through the Forest from dawn to sunset, while, borne on the wings of the soft night wind of June, comes the sibilant song of the Night Jar, or Night Hawk as the forester generally calls it. This strange churring, ventriloquial note is one of the familiar Forest sounds in the dusk of a warm summer's night. Keeping close cover during the hours of daylight, as the twilight deepens into dusk, the Night Jar may be seen swerving and wheeling with great activity and in perfect silence, in pursuit of the insects on which it feeds. One curious trait which helps this beautiful and interesting bird to escape detection, is its habit when alighting on the bough of a tree to rest with its body placed along the bough, and not at right angles to it, as is the habit of most birds. This peculiar habit, coupled with the soft tones of its beautiful plumage, makes

the Night Jar a very difficult bird to watch.

Formerly the Kite, the Honey and Common Buzzard, and the Hen Harrier frequented the Forest, but now, I am afraid, that but for a rare and very occasional, single visitor, they can be no longer counted amongst its feathered inhabitants. The extinction of the Honey Buzzard was undoubtedly hastened by the professional collector, who remorselessly sought for the eggs. It is sad to think that a similar fate must inevitably overtake many interesting and beautiful birds who still make their homes within the precincts of the Forest, unless something is very promptly done to put a stop to the present persecution during the breeding season.

One curious and interesting point in connection with the extinction of the Kite and Hen Harrier, is the remarkable increase in the number of small birds within the Forest; and, probably also thanks to the absence of their feathered foes, many of these birds are becoming wonderfully bold and confiding. Therefore, although one must needs regret the extinction of the noble Kite and Harrier, there is solace in the fact that their absence from the Forest enables one to watch the ways and manners of many a small bird who formerly could only be kept under observation with great difficulty.

As the nesting season advances, there comes from many a bush, and tangle of bramble and bracken, the faint shrilling trill of the baby birds, whose appetites seem to be insatiable. Very gently parting the branches and peeping in, we catch a glimpse of the long, scrawny necks, and quivering heads with eager, gaping beaks, of the unfledged nestlings. Sometimes the sound is stronger and more insistent, and then we may find the nest filled with the spacious form of a full-fledged young cuckoo who a few hours after its birth ousted the rightful inhabitants, and now claims the unremitting attention of their parents, who seem well-nigh distracted by the unceasing demands of their foster-child for food.

THE NEST IS FILLED WITH THE SPACIOUS FORM OF A YOUNG CUCKOO.

A PAIR OF YOUNG LAPWINGS.

The Forest is watered by many pleasant winding streams that are fairly well stocked with fish, and are the haunt of the Kingfisher, who may frequently be seen perched upon some bough that projects across the water, from which coign of vantage it dives to capture its prey, or flies swiftly away if alarmed at our approach, giving us but a momentary glimpse of its exquisite plumage. These streams in passing from the woodland across a belt of open country, widen out and flow between low reed-bordered banks, beloved of the Heron, who may often be seen standing alone, grey sentinel on the shallow margin of the stream.

Out on the lonely marshlands of the Forest, with its dangerous, quaking bogs, we hear the plaintive "pee-e-wit," "pee-e-wit" of the Lapwings, as those beautiful birds, alarmed at our approach, rise and circle above our heads. It seems a sad pity that this graceful and useful bird—it is truly one of the best friends that the farmer possesses—which at one time was common on all the open lawns and spaces in the Forest, is now practically confined to the wildest plains and dangerous marshes, owing to the ruthless manner in which its eggs have been collected during the breeding season. The baby Lapwings are the most delightful, soft, downy little creatures, their markings and colourings so closely resembling the brownish-grey tint of the marshland that, as they huddle close to the ground at the approach of danger, it is practically impossible to detect their presence. The mother bird at your approach stealthily creeps away from her young, and then rising, circles round your head, giving vent to her plaintive cry, and with a tumbling flight, as if cramped or wounded, strives to lead you from her nest or young, her mate joining with her in her frantic endeavour to draw your attention away. Once alarmed it is a long time before the parent bird will return to her eggs or young, and if one would see her settle on her eggs or brood her young, one must exercise some patience and craft. By lying flat amongst the growth of heather and reeds, and very quietly and gradually drawing under the shelter of a bush, we may be able to watch the precautions of the mother bird, who has been alarmed at our approach, ere she returns to her young. After circling in the air for some time, giving vent to her shrill, plaintive cry, to which her mate responds, she will at last settle on the ground and, with her quick, characteristic, running gait, move from place to place on the marsh, giving every now and then a faint, low call. At last, if her fears are allayed, she will draw near to where her young are hiding, and then crouching on the ground, will call her chicks to her; and, with the aid of the field glasses, we may see the tiny, downy youngsters hastily run up and hide themselves beneath the snow-white plumage of their mother's breast. She then gives a series of calls of satisfaction, and her mate, satisfied that all is well, moves off and away in search of food.

In April, when the foresters are in the

full swing of stripping the oak bark, the loud and oft-repeated call of the Wryneck sounds through the woods ; and the men, as they pause in their work, tell each other that the " Rinding Bird " has arrived. This bird, with its delicate, pencilled, grey-brown plumage, has many a popular name besides its forest one of " Rinding Bird," in some counties being known as " April Bird," " Cuckoo's Mate," or " Snake Bird." " Rinding Bird," " April Bird," and " Cuckoo's Mate " are all names which have to do with the season of its arrival ; whilst " Snake Bird " and " Wryneck " tell of two peculiar characteristics ; one of the vigorous hissing noise which the sitting bird makes when disturbed ; the other of its habit of twisting its long flexible neck into all sorts of odd contortions. On account of the wonderful way in which its mottled plumage harmonises with the bark of the branches amongst which the bird delights to hide, the Wryneck is a most difficult bird of which to obtain a good sight. It builds no regular nest, but contents itself with slightly enlarging a suitable hole in the trunk of some tree in the Forest, particularly the stunted thorn tree, and forming just a slight layer of soft rotten wood at the bottom of the hole, upon which it lays its glossy, white eggs. A

A YOUNG WRYNECK AWAITING THE RETURN OF THE PARENT BIRDS.

FOREST PONIES.

little later in the season we may catch a glimpse of a full-fledged nestling peering out from the nest, with craning neck and anxious expression, awaiting the return of the parent birds with food.

Echoes down the long dark glades the hoot of an owl, and in the gathering gloom we catch a glimpse of a large bird as it passes swiftly on broad and silent wing. In an hour the moon will rise, and then we may hear the Tawny Owls call to each other across the lawns. It is astonishing, in the deep quiet of the forest night, how far the hoot of the owl carries. The owls are fairly numerous, and one rarely takes an evening walk without being rewarded with the sight of at least one of these birds starting forth on its nightly foray. During the nesting season they become very bold, and even aggressive, as the ardent entomologist has learned to his cost on more than one occasion when sugaring for moths at night. The parent birds, alarmed by the flashing of his lantern for the safety of their young, will swoop down and attack him with beak and claw.

While the Tawny Owls frequent the forest glades, loving to nest in the hollow of some ancient tree, the Barn Owls keep more to those districts that are under partial cultivation.

As we pass along the sandy bank of an enclosure facing south on a warm sunny autumn morning, we may catch sight of an adder sunning itself at the entrance to a deserted rabbit burrow. This is a very favourite situation with the adders, and a good number seem to hibernate during the winter in the deserted rabbit burrows in the sand banks that face the south. Far from being an aggressive creature the adder is only too anxious to get away if disturbed, and generally will only show fight when cornered, or when trodden upon—an accident which may happen when one is tramping through heather.

Very beautiful is the coming of spring in the Forest, a sight the memory of which will ever remain a cherished treasure in the mind of the lover of Nature who has looked upon it. Here, indeed, one can realise the full beauty and significance of the old Greek Nature myths. All through the long dark nights of winter, have we not heard the voice of Demeter, sighing and calling through the leafless branches of the forest trees, seeking vainly for her vanished child? Look! a golden star amidst the whirl of the restless wind-blown leaves—a single Celandine flower, bringing its promise of good to come. Now in the hazel-wood blossoms the Primrose, lifting a golden chalice, fragrant with hope, to the fitful gleam of the cold

THE BARN OWL.

March sun. Soon the Violets begin to show in the woods, and the air grows sweet with their breath. Already the woodland path is clothed with the white stars of the Windflower, forming a carpet for the dainty footsteps of Persephone.

Yes ! from the underworld Persephone returns, and at her coming the whole forest mantles with delicate green. Down the long leafy aisles comes the glad song of the throstle, bringing Tennyson's beautiful lines to our mind :

"Summer is coming, summer is coming,
I know it, I know it, I know it.
Light again, leaf again, life again, love again,
Yes, my wild little Poet."

And so with the advent of May the Forest bursts into the full glad tide of early summer. F. MARTIN DUNCAN.

CHAPTERS IN PLANT LIFE

V—THE PLANT AND ITS HELPERS

By S. LEONARD BASTIN

With Photographs by the Author

IN the fierce battle of life there is small chance for the exercise of charity. We have no evidence to show, apart from certain instinctive traits, that one being ever helps another unless something is given in return. The plant, owing to the many inherent disadvantages under which it exists, is sorely in need of helpers to enable it to carry out the functions which it is bound to perform. Yet surrounded as it is on every side by enemies, it has not been an easy matter to enlist the services of those who are in a position to lend their aid. To this end some of the more ingenious devices in the vegetable kingdom have been brought into being, and there are few more interesting phases of plant life than the relations of the plant and its helpers.

Although the question is one concerning which there is a great diversity of opinion, it seems almost certain that plants benefit by the cross-fertilisation of their blossoms. It is not easy to avoid the conclusion when one considers all the marvellous arrangements which have been entered into, presumably with this object in view. The fact, too, that in so many cases the male and female organs in the flower mature at different times suggests that self-fertilisation is not wanted. Not the least amazing feature is the variety of the agents which are induced to help the plant in the distribution of its pollen. Insects, spiders, birds—even the wind and water—act as emissaries in this marriage of the plant. The intricacies of some of the relationships are so astonishing that it must always be a matter for

STINKING GLADWIN (*IRIS FŒTIDISSIMA*), A WELL-KNOWN BRITISH PLANT WHICH HAS AN UNPLEASANT SMELL ATTRACTIVE TO CERTAIN INSECTS.

conjecture as to how such things could come about.

Overshadowing all else in connection with the cross-fertilisation of flowers is the work accomplished by insects. It will be no exaggeration to say that hundreds of thousands of species embracing nearly all classes are actively engaged in pollen transference, although it is likely that the insects are in total ignorance of the services which they render. It is evident that it is necessary for the plant to offer some inducement, so that it may appear to be worth the while of the unwitting helper to visit the flower. In most cases this attraction is to be found in the nectar which the blossoms secrete, and this will act as a never-failing bait to draw the insects into making a call. The nectaries themselves present a variety of forms, sometimes appearing as sunk glands, on other occasions being grooved, whilst again they may resemble small warts. These processes are, as well, placed in different parts of the flower—in the Japanese Lily they exist as grooves on the perianth, whilst in the Buttercup we may find them at the base of the petals. Even the essential organs themselves are nectary bearers, as is to be seen in the case of the shortened stamens of the Cuckoo Flower, and the ovaries of the Antirrhinum and Veronica.

The showy flowers of the Grass of Parnassus are of special interest, from the

fact that in the centre of each bloom an arrangement of five hairs gives rise to a curious illusion. Each of these processes presents the appearance of being tipped with a shining drop of nectar, although, as a matter of fact, the flower is quite devoid of honey. Anyone who cares to watch the flowers of this charming bog plant on a fine summer day, will see that a large number of flies are deceived into the belief that the glistening points will yield them some reward if they visit the flower. The little insects seem to be quite disgusted when they discover that the feast of honey which they had expected to find does not exist at all. Yet the clever plant has achieved its object in drawing the attention of a visitor who will be likely to aid in the dispersal of the pollen.

It seems almost certain that in not a few cases the pollen itself is offered as an inducement to the insect to visit the flower. There is little doubt that large numbers of small beetles, which in one way may be regarded as robbers, act as the agents for the carrying of the pollen from one bloom to the other. This is easy to understand in the case of those plants which produce pollen largely in excess of their actual needs. An observer has been at pains to count the number of grains produced by the flower of the Hibiscus. It was estimated that sixty grains would be amply sufficient to fertilise all the ovules of the blossoms,

SIDE VIEW OF THE FLOWER OF *ARISTOLOCHIA GIGAS*, SHOWING THE TORTUOUS PASSAGE IN WHICH THE FLIES ARE ENTRAPPED.

whereas in a normal case the stamens were responsible for five thousand. Even this number is small compared with the quantity of pollen grains produced by the Dandelion, estimated at nearly four hundred thousand; whilst in the case of the Pæony the number has been placed at between three and four million!

There is no doubt that insects are often attracted to flowers by their appearance and scent. Many blossoms advertise their presence by the gay colours which they display and the sweet perfumes which they exhale. Almost all kinds of flies are very prone to settle on anything which is strikingly marked, and not a few plants have turned this tendency to account. The observations of many students of this particular phase of plant life have gone to show how gaily coloured flowers receive first attention. It has also been demonstrated that certain insects are attracted by a particular colour, and choose this in preference to others. Thus, from the experiments of Lord Avebury it appears that bees will, if there should be any choice in the matter, select the blue flowers, while flies seem to be more partial to those of a yellow or brown tint.

POINSETTIA PULCHERRIMA, FROM SOUTH AMERICA.
The bracts surrounding the insignificant flowers are flaming crimson in colour.

Many species with insignificant blooms have called to their aid showy bracts to advertise the presence of their flowers. Of these, the South American Poinsettia is one of the most striking examples. In this case the true flowers are unattractive and would certainly never be noticed on their own merits. However, the flaming red bracts which encircle the small blossoms are so imposing that there are few more striking sights than the Poinsettia in perfection. In the same way the Bougainvilleas have emphasised their small dull yellow blossoms by encircling them in three bright pink bracts. As a result this plant is quite one of the most showy features of the tropical forests.

Many flowers are favoured with attention owing to the resemblance they bear to some object which the insect is likely to regard with favour. Nearly all flies are fond of visiting rotting meat or similarly offensive matter, and this tendency has been taken advantage of by many plants. The simulation is kept up, both in the appearance of the bloom and in the smell which it emits. The British Field Iris has been called the "Roast Beef Plant," owing to the curious odour which the flower gives out, although the smell is scarcely so appetising as that of the cooking joint. A Southern European Arum (*A. dracunculus*) is so offensively scented that the plant is hardly a fit subject for culture in the garden. Moreover, the tinting of the flower is of a lurid brown colour, not unlike the colouring of rotting meat. Most remarkable of all, however, are the South American Aristolochias, plants mostly producing huge flowers coloured in brown and white. The form of the flowers of these Aristolochias is also very singular, and in one species long portions trailing away from the body of the bloom give the impression of drippings from a

large piece of meat. As well, the flowers of the Aristolochia emit a horrible odour, which is so nauseating that a person cannot stay long in the vicinity of a blossom. That this simulation is not in vain, may be gathered from an examination of the interior of the bloom, which is crowded with flies come in search of the imagined dainties.

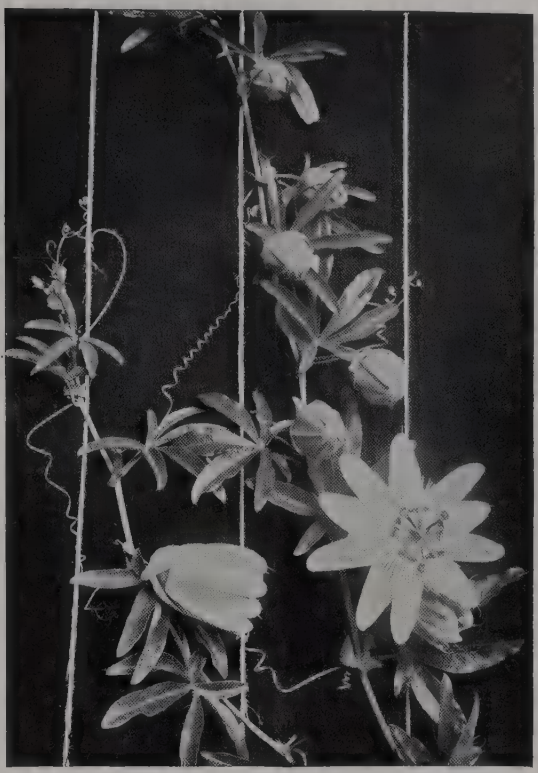
Having attracted the insect to the flower, it is necessary to make sure that it does not go away without its burden of pollen. In almost every case of a flower fertilised by insect agency, the pollen grains are either sticky or else covered with excrescences which cause them to adhere readily to any object. As a curious contrast, the pollen produced by wind-fertilised plants is almost always smooth and free from any projections. With a large number of flowers, especially in the case of the Compositæ, the insect visitor in his wanderings brushes up against the anthers of the stamens, and in this way becomes dusted with the pollen, which is likely to be carried to the next bloom visited. The Peacock Butterfly, which sips nectar from the clustered bloom of the Scabious, cannot fail to get a certain amount of pollen over his legs and body. In like manner the bee which blunders into the Crocus blossoms will, both at her entry and exit, be certain to have her body freely powdered with the golden dust.

In such cases as these we see the relations of the plant and its insect helper at their simplest. Far more elaborate arrangements have been devised to ensure the effective distribution of pollen by insect agency. Many of these are especially remarkable owing to the fact that the flower is designed for the visits of one class of insect, or perhaps for a single species. Thus a number of exotic plants which are introduced into British gardens can never be effectively cross-fertilised, simply because none of our indigenous insects is fitted for the task. A rather curious case is that of a Brazilian species, *Araujia albens*, a plant which is of fairly easy culture in the south of England. In its native country the cross-pollination of the *Araujia* is carried out by large humble-bees, strong enough to force their way in and out of the curious trap-like contrivance which guards the pollen masses. In other places, however, where the plant has been introduced, the flowers are largely visited by moths, which, unaware of the curious device, thrust in their probosces in search of the nectar. Too late the unfortunate insects find that they are caught in a trap from which they have not sufficient ingenuity to release themselves. So they flutter away their lives in vain endeavours to escape.

Undoubtedly the largest number of special arrangements in flowers have been made with a view to the reception of bees. However these extraordinary relations have arisen, the plant could scarcely have secured a more industrious and systematic worker. It has been computed that an average bee will visit three or four hundred blossoms on a summer day, so that even where flowers are in great profusion we may take it that not one will escape attention from the winged visitors. The way in which many flowers have been specially designed in order to keep out unwanted callers has been dealt with elsewhere, but it is interesting to consider the ease with which the right visitor can obtain an entrance. Most people must have watched a humble-bee open that "strong box," the Antirrhinum flower. How convenient is the little platform on which the insect may alight and secure a firm hold with her legs in order that the contrivance may be forced open!

Even as the bee takes her measure of the nectar, she receives a dusting of pollen from the anthers. More ingenious still is the arrangement in the case of the Pea. In this flower the stamens and pistil are contained in a process formed by two petals joined together, generally spoken of as the keel. At a certain stage in the development of the blossom, the anthers discharge their sticky pollen into the cavity at the tip of the keel. Now it is just at this time that the Pea makes its greatest effort to attract attention; the standard is fully spread, the fragrance given out is at its strongest, whilst the supply of nectar is all in readiness for the expected visitor. At last the bee alights, taking up its position on the two lateral petals while

it prepares to feast at the banquet. The weight of the insect at once depresses the keel of the flower, and the style, being a fixture, is forced through the hole at the end of the process. Now the end of the style has been provided with a brush, and this in its passage through the conical part of the keel becomes plentifully laden with pollen. Naturally the underneath part of the bee is well dusted with the yellow grains, and the stigma of the next flower the insect calls at will be certain to receive a share of pollen from the last bloom visited. By an equally ingenious device the Sage blossom ensures that the bee shall not fail to act as an agent for the transmission of its pollen to another flower. Here, again, we find a convenient little platform on which the insect may alight. As is the case in so many flowers, the anthers and the stigma mature at different times. The stamens of the Salvia are arranged in the form of a very curious contrivance. Two of the anthers are quite rudimentary; but the others, instead of being affixed to the filament of the stamens in the ordinary way, are arranged on a connective in the form of a swinging rod. When the flower is ready for the reception of the insect the movable rod is in an upright position.



PASSION FLOWERS ARE LARGELY FERTILISED BY HUMMING BIRDS.

Now the nectaries are situated deep down in the flower, and the bee in her search for the sweet stuff must needs come in contact with the terminal knobs of the connective. Thus the rod is forced round, and the anther lobes at the other extremity deposit their pollen upon the back of the insect. The style of the Salvia is in the hood-like portion of the flower, and until its time for maturing arrives it is comparatively short; as its development proceeds, however, the organ extends downwards. If the next Salvia blossom visited by the bee should be in the female state, the stigma will be in just the position to meet the back of the insect which has previously been dusted with pollen. In this way the cross-fertilisation of the flower is secured.

In considering the question of cross-fertilisation by insect agency special attention must be directed to the Orchids. If it can be contended that complication of design is typical of a high order, then we must place the flowers of these strange plants in the forefront. The very formation of the Orchid blossom is so intricate that it is not at all an easy matter to distinguish the different parts.

In the typical Orchid flower we find three fairly distinct sepals, although even here the two lateral ones are sometimes joined together over the interior part of the flower. The petals are also three in number, one of them frequently being much larger than the others, and forming a curious pouch which projects well forward. Even the essential organs have undergone some remarkable modifications, so that it is quite impossible to recognise any stamens as such, the pollen being produced in two bag-like contrivances which are united to the stigma. As might be expected, the means by

which the cross-fertilisation of such a complicated flower is carried out present many points of interest. The story of the cross-fertilisation of the Early Purple Orchis (*Orchis mascula*) is one of the most fascinating in the world of plants. An examination of the flower will show that the petal forming the lip is carried backwards into a spur which, although it contains no nectar, is valued as a food substance in itself by bees. Now the head of the insect in search of the succulent tissue comes into contact with two sticky discs attached to the stalks of the pollen masses; so that when the bee emerges the pollinia are carried away.

THE POLLEN MASSES MAY BE REMOVED FROM THE FLOWER OF THE PURPLE ORCHIS ON THE POINT OF A PENCIL.

At first the pollen masses stand erect, but in about half a minute, owing to a beautiful arrangement whereby the base of the stalk contracts, they incline forward. Thus by the time the bee has arrived at the next flower the pollen masses are in such a position that they cannot fail to strike the stigma. The manner in which the pollen masses are attached to the head of the bee may be well seen if the point of a pencil is inserted into the cavity of an orchid flower, and then gently drawn away.

It is not always that the plant, after attracting the insect to pay a visit, is willing to let the creature take its departure at once. In the case of *Aristolochia clematitis*, gnats and other insects are sometimes held prisoner for sixty hours until the work which is required of them has been performed. The essential organs are contained in a kind of bulbous swelling at the base of the flower, to which entrance is only possible through a narrow tube. This passage way is lined with stiff bristles pointing downwards, through which the incoming insects are easily able to force their way.

When the flies arrive the stigmas are in readiness to receive the pollen which the visitors will bring with them; meanwhile the insects are regaling themselves on the tissue which forms the walls of the apartment in which they are really prisoners. When they think they would like to depart and make attempts to fly up the tube, it becomes evident that no escape is possible through the hairs, which completely bar the way. It is not until the end of three days that the anthers have come to perfection, and the flies in their frantic efforts to escape become well dusted with pollen, that the barrier dries up and the captives are allowed to go on their way.

Among our hedgerow plants the common Cuckoo Pint is an interesting study of the way in which insect visitors are held captive. Without pulling aside the greenish spathe of the arum it is impossible to see the true flowers, which are clustered round the base of the upright column called the spadix. At the bottom of all are to be found the female flowers, and just above them is the ring of male blossoms. Higher still we find a mass of hairs pointing downwards. The ovary-bearing blossoms mature first, and at that time give out rather an unpleasant odour which is peculiarly attractive to flies. The insects arrive in numbers, many of them well dusted with pollen from other arums which have been visited, and find it an easy matter to go down through the palisade of hairs. After visiting the female flowers, each of which produces a drop of honey, the little visitors do not find it such a simple business to escape upwards through the

array of hairs. Indeed, it is not until the stigmas have withered, and the anthers have come to perfection, dusting the flies with pollen, that the fringe of bristles dries up and allows the flies to go about their business once more.

It is known that humming birds play a considerable part in the fertilisation of many tropical American plants. By their peculiar habit of flight, these little birds are well adapted for hovering over blossoms and sipping the nectar from the blooms with their long beaks. A great variety of flowers appear to be visited by these tiny creatures, although they seem especially to favour the blossoms of the Fuchsia and Lapageria, as well as some of the Passion Flowers. In Britain a large number of our trees are cross-fertilised by the agency of the wind, and in no cases are the blossoms large or gaily coloured. Most people must be familiar with the long hanging catkins of the Hazel, which as they reach their maturity are among the first signs of approaching spring. These are, of course, only the male organs of the plant, and it requires some searching to find the clusters of crimson threads which represent the stigmas. On a day when the anthers have come to perfection the smallest puff of air blows the pollen in little clouds through the leafless branches, and a certain amount of it is sure to find a resting place on the female organs and in this way to bring about pollination.

THE NECTARIES OF THE CUCKOO FLOWERS ARE AT THE BASE OF THE TWO SHORT STAMENS, WHILST THOSE OF THE BUTTERCUP ARE AT THE BOTTOM OF THE PETALS.

The Scots Pine presents a most striking example of a tree which relies upon wind fertilisation. In the month of June, when the anthers arrive at maturity, we may see the pollen hanging over the branches in dense clouds. The dispersal of the grain from the male flowers to the undeveloped female cones is facilitated by the fact that the pollen is provided with minute wings. At the time when the pollen floats away on the breezes the ovules on the female cones exude a sticky substance, which ensures the retention of any grains which happen to come in contact with it.

A certain number of plants rely upon water as a medium for the distribution of their pollen. Of this a British marine species, the Grass Wrack, is an example. The pollen grains are here of tubular form, and being of like specific gravity to the water, are conveyed by the currents from the anthers of the male flowers to the stigmas of the female organs. More strange still is the story of the Italian Eel Grass (*Vallisneria spiralis*), a native of Southern Europe. The male and female flowers are produced on different specimens, and at first both kinds are developed low down, quite close to the roots of the plant.

As soon as the female blossoms have nearly matured, however, the long stems on which they are borne (previously packed away in a receptacle) unwind and bring the flower heads to the surface. At this time the submerged male buds become detached and rise to the surface. After a short interval the blossoms open back three sepals, and in this way form a kind of raft upon which they can float about, driven in all directions by the wind. Sooner or later the majority of the little boats will be certain to come to a halt against one of the female blossoms, with the result that the projecting stamens can discharge the pollen grains upon the waiting stigma. After fertilisation the long stalk of the female blossom coils up spirally, and gradually carries the ovules down to the mud bottom, where the seeds may ripen in safety. S. Leonard Bastin.

THE MOLE CRICKET.

THE CRICKETS

THE FIELD CRICKET THE MOLE CRICKET THE HOUSE CRICKET

By DOUGLAS ENGLISH, B.A., F.R.P.S.

With Photographs by the Author

THE Crickets, who are represented by four species in this country, present features of such interest and novelty that it is hard to account for the indifferent attention which they have received from British authors. Little has been added to our knowledge of their life habits since White, of Selborne, wrote of them in 1778. He devoted three letters to a description of the three species known to him, and would no doubt have added a fourth had he been acquainted with the scarce Wood Cricket. These letters (XLVI.—XLVIII.), which are written with characteristic simplicity and directness, give one the impression that the Field Cricket, Mole Cricket, and House Cricket were in White's time comparatively common in the neighbourhood of Selborne. It is true that of the Field Cricket he says, "Though frequent in these parts it is by no means a common insect in many countries," but he makes no comment on the distribution of the Mole and the House Crickets beyond noting that the latter resides "altogether within our dwellings," and that the former often "infests gardens by the sides of canals." That White took great interest in the Field Cricket is shown by the fact that he made more than one ineffectual attempt to transplant individuals from "Short Lithe" to his own garden; he had excellent reasons for preferring

to study the Mole Cricket in other people's gardens.

"Short Lithe" is described in Letter XLVI. as a steep, abrupt pasture field interspersed with furze, consisting of a rocky dry soil and inclining to the afternoon sun.

It would need but slight modification to make this description strictly applicable to the locality where I first heard, and soon afterwards first saw, the Field Cricket.

Let the reader picture a sun-burnt, grassy slope, fringed on its summit by a coppice, and with its surface broken here and there by stunted brambles. Half-way up it he might, on the occasion referred to, have seen a crouching figure, bent almost double, working stealthily upwards, tip-fingered and tip-toed, searching the ground with infinite precaution, now pausing rigid as a stone, now slowly stretching out a hand to part a grass tuft. The Cricket hunter must go slow. He must let neither flicker in the grass nor whisper in the air escape him. Above all, he must know what to look for. Apart from the welcome sound of stridulation, there are certain definite signs which in time lead him to his quarry. Field Crickets are solitary insects, and reside in burrows of their own making. From these during the daytime they seem never to move more than a few inches, and their feeding on the grass and roots in the immediate vicinity (Mr. O. H. Latter, to whom I owe my first introduction to Crickets at large, informs me that they are especially fond of the "bulbs" of the bulbous buttercup) often results in the presence of a bare patch of soil, two or three inches square, immediately before the burrow entrance. A stridulating Cricket is usually about half-way out of his hole, presenting his back to the landscape. A Cricket who is sunning himself, or lying in wait for smaller insects (Crickets by no means confine themselves to a vegetable diet), faces outwards, or, it may be, climbs a few inches up the neighbouring grass stems. In either case the slightest vibration will send him backwards or forwards down his burrow.

Field Crickets breed in the warm summer months. I have never witnessed courtship in the case of Field Crickets at large, and I fancy that it must occur after dark. In the case of captives the male commences by stridulating with the utmost energy, and so calling the female's attention to himself. Once this is effected he circles round her, drawing closer and closer and chirruping in a jerky *staccato* fashion. His final advances are made backwards.

The female's ovipositor is a flimsy one compared with the corresponding organ in Long-horned Grasshoppers, and it is to be presumed that the eggs are deposited in crannies in the ground, or, perhaps, in the recesses of grass tufts. The larval Crickets are pale in colour. They pass through six or seven moults before hibernating, in somewhat deep holes of just sufficient diameter to admit

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THREE STAGES IN THE DEVELOPMENT OF A FIELD CRICKET.

1. Larval stage (September). 2. Nymph stage (March). 3. Imago stage (July). In 2 the body is covered with a fine golden down, and the rudiments of the wings appear. In 3 the wing-covers are fully developed, concealing the wings entirely.

their bodies. It is said that the entrances to these holes are sealed up from within.

Quite early in the spring, the actual date depending on the forward or backward character of the season, the young Crickets of the previous year awaken to activity; but it is not until they are nearly mature that the sexes can be at all easily distinguished. Maturity is marked in the male by the appearance of stridulating wing-covers, and in the female by the complete development of the ovipositor. In the nymph stage, and even earlier, both males and females display a golden sheen due to a fine pubescence on the abdomen; but the mature male is, with the exception of a yellowish band at the base of his wing-covers and a deep-red edging to his hinder thighs, a peculiarly black-looking insect. I am inclined to think that in the case of Crickets, as in the case of Long-horned Grasshoppers, there is a tendency for either male or female to predominate in different broods—it is possible that the broods may be exclusively male or exclusively female; and that the females are less abroad than the males during the daytime.

In July, 1908, Mr. Latter and I caught nothing but males, taking them at the entrances of their burrows, and at that time Mr. Latter had not yet taken a female. In September, 1908, Mr. Latter took a number of larvæ from the same spot by digging, which turned out to be all females. In April, 1909, he took immatures of both male and female in about equal numbers, the holes then having the appearance of having been for some time open. Both in July, 1908, and in April, 1909, an unexpected lodger in the shape of a Carabid Blackbeetle was found not infrequently in the holes, and it was due to the presence of such a beetle that I was enabled to secure my first record of a Field Cricket.

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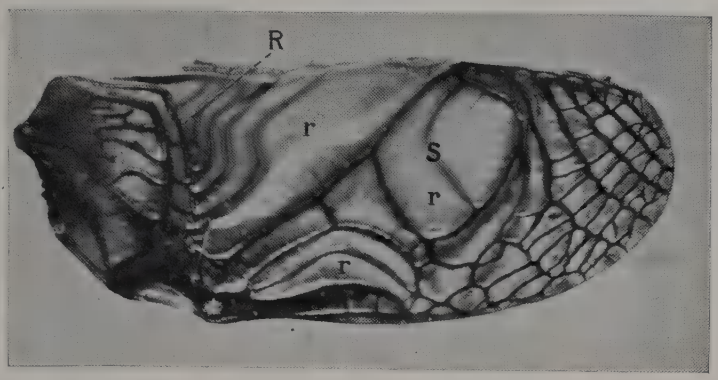
THE HOUSE CRICKET.

1. The female. 2. The male. 3 The female. The female's ovipositor should be noticed, and the difference in the wing-covers of the two sexes, the male's alone being a stridulating organ. The wings project as two thongs some way beyond the wing covers, the other paired projections being the *cerci*, probably sense-organs, possibly organs of direction.

I had been fruitlessly endeavouring to erect my camera in such quiet fashion as to avoid the contingency of the subject making a prolonged stay in the depths of his burrow, and I was not a little surprised to find that this Cricket, who, like the rest, had vanished at the most inopportune time, reappeared backing at top speed, shot out an inch or so beyond the entrance, reversed, and then stopped dead at a point where he could be photographed. For the moment I took no risks, but as soon as I had secured my picture I commenced to tickle him with a grass stem. Instead of bolting down his hole he kicked like a mule, nor could any further provocation drive him downwards. I thereupon took him up, and a glance within



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THE CRICKET'S INSTRUMENT OF MUSIC.

1. The under surface of the horizontal portion of the wing-cover of a male Field Cricket. R, the round-file nervure ; r, r, r, the resonating surface. S, the portion of the resonating surface known as the speculum. In 5 the round-file nervure is seen more highly magnified.
2. The upper surfaces of the horizontal portions of the wing-covers of a male House Cricket, showing the relative positions of the round-file nervures, and of the resonating surfaces when the wing-covers are opened apart.
3. The under surface of the male Field Cricket's left wing-cover, showing both the horizontal and the perpendicular positions.
4. The upper surfaces of the right wing-covers of the male and female Mole Cricket. These are important, as affording the only external means of distinguishing the two sexes. It will be seen that the resonating surfaces in the male (on the left) are more complicated than those in the female.

the hole explained matters. The beetle, whose face I at first mistook for that of another Cricket, was on guard, and effectually barring the entrance. That the Cricket should not have scuttled into the grass was remarkable. It would seem, however, that escape through an avenue of grass stems is not much practised by Field Crickets. At an early stage, such as that of which I give an illustration on page 959, they are extremely lively, and can jump well. As they progress in months, however, their active habits seem to leave them, and once they are headed from their holes they are easily captured. More than one observer has expressed surprise that with their by no means contemptible armament they do not show fight. The Field Cricket is to outward appearance an extremely powerful insect. His round bullet head, his trenchant mandibles, his stout hind legs armed knee to heel with spurs, his steely eye, and his determined attitude, give one an impression not only of brute strength but of science. His looks belie him. The indignity of capture which provokes frantic savagery in the Earwig leaves the Field Cricket limp.

With his own kind he is warlike enough —the males wage battle furiously ; and, judging by his dealings with insects smaller

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STUDIES OF THE MALE FIELD CRICKET.

In 1, the vertical portion of the outside stridulating wing-cover can be well seen, and in 2 and 3 its length in relation to the insect's body and its aspect as viewed from above. In 5 the Cricket is "stridulating"; the wing-covers are elevated at an angle of 45°, and the folded flight wings are exposed on either side of the body. In 6 the Cricket is cleaning one of his antennæ by passing it through his mandibles.

than himself in captivity, we are justified in supposing that, in the adult state at least, he is largely carnivorous, and that he sits at the entrance of his burrow waiting for such unwary insect travellers as may alight on it, or cross it.

This supposition is strengthened by the rudimentary development of the Field Cricket's flight wings. The power of flight in insects is in close relation to their natural food supply, and to the means of communication between the two sexes. In the case of Field Crickets, the latter is assured by their gregarious character, coupled with the males' power of stridulation. The folded flight wings of all British Crickets present the appearance of narrow twisted thongs, which, as a rule, project beyond the covering afforded by the wing-covers, and which may project (this is often the case with the Mole Cricket) in a downward curve beyond the hind extremity of the body. Since they are not only folded but rolled, their arrangement at rest is remarkably like that of a rolled-up umbrella. They may be easily spread out with a paint-brush on a moistened slip of glass, and it will then be found that they have a characteristic form which may be described as semi-heart-shaped.

I am doubtful as to whether the expanse of a Field Cricket's wings is sufficient to give him the power of true flight. Gilbert White describes the flight of the House Cricket—who, it should be noted, has much larger wings and a proportionately slighter body—as a wave motion: "*volatu undoso*, in waves or curves, like woodpeckers, opening and shutting their wings at every stroke . . . always rising or sinking"; and says that the flight of the Mole Cricket is accomplished in a similar way. It is possible that a suitable disposition of the wing-covers may assist the progress of both insects, and I may perhaps mention in this connection that the common orange and black Burying Beetle almost inverts his elytra in flight so that their concave portion is uppermost.

The stridulation of Crickets is effected, like that of Long-horned Grasshoppers, by the friction of the wing-covers against one another; but the wing-covers of Crickets are far more highly specialised than those of Grasshoppers. Both right and left are of the same pattern, and apparently interchangeable in position, the left being perhaps most frequently uppermost. A remarkable and characteristic feature of them is that they are divided into two distinct planes, the lower portion of each being parallel to the insect's side, while the upper portion, bent away from it almost at right angles, lies upon the insect's back. It is this upper portion which is employed as an instrument of music. The principal nervures on it may be said to radiate from a point on its inner edge close to the base, which is surmounted by a tuft of bristling hairs. From this hair-tuft, taking the Field Cricket as the type, a stout nervure leads diagonally across the horizontal portion of the wing and, towards the end of its course, borders a transparent oval disc, the main sounding-board, which is about one-eighth of an inch in diameter. From the same point two nervures run directly across the horizontal portion, but before reaching its outer edge turn sharply towards the base. A portion of the hindermost of these is notched like a round file.

As can be seen from the illustration, the nervures at the tip of the wing form a meshwork, but on the remainder of the horizontal portion they branch into bold and often symmetrical loops and curves which enclose considerable areas of membrane.

In stridulating the Field Cricket ducks his head, raises his wing-covers at an angle of about 45°, and shudders them together so that the under surface of the one brushes lightly against the upper surface of the other. This brings the round-file nervure into play against the nervures of the wing-cover beneath it, which in turn convey the vibration to the membranes which they enclose. The sum of the vibrations induced in the membranes of *both* wings is the Cricket's note. It is a sound similar in mechanism and character to that produced by running a stick along a paling, and is, of course, in no sense vocal, though it admits of considerable variation in pitch. The note of the male solitary but hopeful differs decidedly from that of the male in proximity to the female. He can evidently

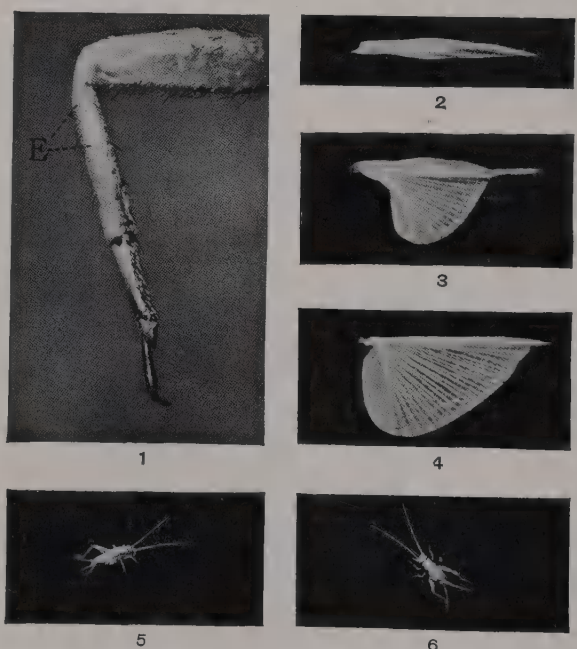
control both its vehemence and its phrasing, can stop it instantly (it is noticeable that when alarmed he ceases shrilling but keeps the wing-covers raised in readiness for a fresh start), and can recommence either with a sharp attack or with a cautious crescendo.

The male House Cricket's wing-covers are of nearly the same design as those of the Field Cricket, but smaller and of more delicate construction. In the Mole Cricket there is not nearly so much distinction between the wing-covers of the two sexes, but such distinction as exists is of great importance, as it affords the only simple means of distinguishing the male Mole Cricket from the female.

Though several Mole Crickets have passed through my hands, I have neither seen nor heard their stridulation, which was once described to me by a very capable observer as resembling "the tinkle of a tiny silver bell." White makes mention of it as "a low, dull, jarring note, continued for a long time without interruption, and not unlike the chattering of the fern owl, or goat-sucker, but more inward." The descriptions may be best reconciled by assuming that the Mole Cricket varies his tune.

The note of both Field Cricket and House Cricket can be feebly imitated by rubbing the wing-covers of dead specimens together, or by causing them to vibrate with a pin-point, but in the stage reproductions of the "Cricket on the Hearth" the "chirrup" is, I believe, effected by twisting the glass stopper of a bottle, and is decidedly more truthful than most stage noises.

There are innumerable species of small insects in this country whose adaptations to their surroundings can only be realised by studying them alive under the microscope. Among such one occasionally finds modifications of structure which are as extraordinary as they are unexpected; but among our sizable insects—insects, that is, whose form can be seen at a glance—the Mole Cricket occupies a unique position. It is perhaps as well that his distribution is somewhat restricted. Essentially an underground feeder, with a preference for made ground and such vegetable products as are to be found in made ground, he is, in all parts of the Continent where he is abundant, regarded as an unmitigated pest. Like his namesake, the Mole, he drives subterranean galleries, which radiate in all directions from a central cavity in which he lies up during the cold season. This cavity is generally reached by a perpendicular descending shaft. Were his diet mainly carnivorous, his tiny hillocks and the slight disturbances of the surface soil caused by his working might be debited against his services in destroying grubs. There is, however, little doubt that he is vegetarian as well as carnivorous, and that the havoc which he occasionally causes on the Continent in flower gardens, kitchen gardens, and even in cornfields, is due not only to his pulverising any roots which bar his passage, but also to his frequent indulgence in a square vegetarian meal by the way.



1. The "ear" (E) of the House Cricket. The "ears" of the other Crickets and of Long-horned Grasshoppers are situated in the same position on the front legs. It is possible that they are organs of orientation as well as of hearing.
2—4. Three stages in the unfolding of a House Cricket's wing, which, at rest, is partly folded and partly rolled.
5, 6. Larval House Crickets.

He is a remarkably prolific insect, and the only reliable means of lessening his numbers is the destruction of his eggs. This may be accomplished by following a surface run with the finger until one reaches the perpendicular shaft, sometimes as much as a foot in depth, which leads to his breeding quarters. A spade is then driven in suddenly, and, if fortune favours, the "nest" is turned up. The latter is merely an excavation of about the size of a tennis ball, which often contains nothing, but which may contain the female Cricket surrounded by her eggs, sometimes as many as three hundred in number, or by her immature progeny. It is obvious that this method is a slow one, and that it entails considerable labour. Numerous experiments have been made by Continental agriculturists with the object of bringing oil into contact with the Mole Cricket's spiracles. If this can be done, it is a highly effective means of destruction, but the expense and uncertainty attaching to it preclude its employment otherwise than on quite a small scale, and the discovery of some more certain, more easily applied and cheaper remedy would be warmly welcomed on the Continent.

In Great Britain the Mole Cricket, whatever may have been his distribution in Gilbert White's time, must now be reckoned a scarce insect. He is common in the Channel Islands, but with this exception he is practically confined to that small group of southern counties which appear to derive their fauna from their proximity to the New Forest. All observers, from Gilbert White onwards, are agreed as to his normal liking for moist surroundings, and I have found captive specimens thrive best in a moist heat, care of course being taken not to cause them discomfort by any unnecessary exposure to sunshine.

A few lines must be devoted to the House Cricket—the "Cricket on the Hearth." How much of his fame is due to his comparative abundance, and how much to the genius of Charles Dickens, it is impossible to determine. From the frequency of reference to him in literature of the past, and the infrequency of first-hand experience of him in literature of the present, I am inclined to think that he is less common than he used to be. It has been suggested that the Cockroach has supplanted him in the kitchen, though he still holds his own in the bakehouse. He must be regarded as a parasitic insect; it is very unusual to find one out of doors, and, when he *is* out of doors, he is usually in the manure heap. His original starting point is as much of a mystery as is that of the rats or mice. His song is pleasing to some ears, but I must confess that it soon becomes monotonous to my own. Unlike the Field Cricket, he is an excellent jumper and runner, and requires some catching, the simplest method being to invert a tumbler over him. I have found him a most difficult insect to keep in captivity, even when due precautions have been taken to keep him in a high temperature. The degree of heat which he enjoys, the ease with which he can scuttle over smouldering embers, and the frequency with which he will wedge himself between hot-water pipes, are alike astonishing. Unlike most insects whose habitations are dark, he is a light ash-brown when mature, and whitish in the early larval stages.

THE FOREQUARTERS OF A SPECIMEN MOLE CRICKET.

The extraordinary modification of the fore limb into a digging tool should be noticed. C, the coxa. F, the femur, or thigh, with a blade projection from the base, which engages (see left-hand limb) with the hindmost projection of the wonderful tiba, or shin, T, forming a pair of shears. Only the extremities of the tarsal joints, T^1, which form another pair of shears with the tibia, T, are visible. It has been estimated that the Mole Cricket employs a force equal to 2 or 3 lbs.

Of our fourth species, the Wood Cricket, I have no first-hand knowledge. Though abundant on the Continent, he appears in this country to be confined to the New Forest. DOUGLAS ENGLISH.

DEWBERRY (IN FRUIT).

FAMILIAR WILD FRUITS

By BENJAMIN HANLEY

With Photographs by the Author

AS the harvest-tide of the year approaches and flowers give way to seed and berry, when Nature puts on her autumnal dress of gold and bronze, many kinds of wild fruits may be found up and down the countryside. Of these the hedgerow has a goodly share, and although to the great majority the one and only fruit of the hedge is the Bramble, there are, nevertheless, others even more interesting.

The first likely to be noticed is that of the Hawthorn (*Cratægus oxyacantha*), great bunches of fruit, known as "haws," lining the branches and giving the bush quite a ruddy tinge. These have resulted from the clustered creamy foam of the "May" blossom. During the winter months these haws form the staple diet of many birds of the thrush family; our winter visitor, the fieldfare, would be badly off indeed but for these. The missel thrush sets apart a bush for his own special use, and jealously guards it, fiercely attacking any feathered robbers, and almost all day long in early winter one may hear him harshly protesting against their thievish ways. The haw has a thin, fleshy coating, and beneath this is a hard woody case containing the seed. The Hawthorn is a very valuable material for hedge-making; that this was known to our ancestors is proved by the fact that its name is derived from a Saxon word meaning "hedge thorn."

Towards the foot of the hedge one may find berries almost like those of the Bramble, covered with a rich purple bloom. This is the fruit of the Dewberry (*Rubus cæsius*), a near relative of the Common Bramble (*Rubus fruticosus*). It may be recognised by its more slender branches, which possess only very small prickles. Again, it does not flower so profusely as the

HAWTHORN (IN FRUIT).

Bramble, and the blooms are larger and pure white, whilst the fruit is made up of fewer, larger grains. The purple bloom gives it a very tempting appearance, and it does not belie its looks, for if tasted it will be found far richer in flavour than the more common fruit. The blackbird is especially fond of this fruit. The novice may always tell whether a fruit is the Bramble or Dewberry by looking at the five segments of the calyx at the base of the fruit. If these are thrown back round the stem it is a Bramble, but if they rise round the fruit, a Dewberry.

The Crab Apple (*Pyrus malus*) may frequently be met with as a tree of considerable size, but more often it is seen merely as a shrub or small tree growing in the hedgerow. The blossom in spring, in the opinion of many, is the most lovely of all our wild flowers, and the rosy-cheeked fruit is certainly very beautiful in appearance, but, being rich with malic acid, they are by no means pleasing to the palate; all the same, however, a delightful jelly can be made from them, and in former days a kind of cider was also manufactured from this fruit.

A very common fruit of almost every hedgerow is that of the Black Bryony (*Tamus communis*). This is the plant whose trailing leaf-wreaths rival all other climbing plants during the summer. Then the leaves are very bright and dark green, sometimes purple-black, but in autumn these change like other foliage and become yellow or brown. The berries, borne in clusters, pass from green through yellow and orange until they assume a brilliant scarlet hue. As the fruit may be seen in all these stages in early autumn, the plant looks very attractive from a distance. At the same time, the fruit never strikes one as being tempting, and, if tasted, one would be sufficient, as it is raw and acrid in flavour. The berries remain on the twining stems long after the leaves have fallen,

BLACK BRYONY (IN FRUIT).

WOODY NIGHTSHADE, OR BITTER-SWEET (IN FRUIT).

flowers, borne in small clusters, are deep purple, with bright yellow anthers. It is interesting to note that the clusters of flowers invariably all face one way and the leaves another. The fruit, ovate in shape, is at first a bright green, but as it travels towards maturity it changes gradually until it becomes a rich crimson like the berries of the Bryony. Each fruit contains a number of seeds. This plant is often mistaken for its more dangerous relative, the Deadly Nightshade, or Dwale (*Atropa belladonna*), which bears solitary pale purple, bell-shaped flowers and dark purple berries almost as large as a cherry. Fortunately, this last is the rarer of the two, but it should also be added that the juice of the stem of the Woody Nightshade is poisonous.

The Alder Buckthorn (*Rhamnus frangula*) is a fairly common shrub, and, indeed, is more often met with and give quite a touch of colour to the otherwise bare hedge.

The Black Bryony is especially interesting as being the sole British member of the Yam family. This plant should not be confused with the White Bryony (*Bryonia Dioica*), for although both are climbing plants, and both produce red berries, they belong to totally different families. The leaves of the White Bryony are large, five-lobed, and rough in texture, and from the stem at the base of each is a long spiral tendril. The leaves of the Black Bryony, as I have already noted, are very bright, heart-shaped, with smooth edges; and this plant has no tendrils, but climbs by means of its stem.

Another wild fruit almost sure to be noticed is the Woody Nightshade, or Bitter-Sweet (*Solanum dulcamara*). The latter name is given from the fact that if a piece of the stem be tasted it will at first be found bitter, but afterwards sweet. This plant grows in the hedgerow, forcing its stems amongst other sturdier plants, so gaining support from them. The

CRAB APPLE (IN FRUIT).

than its near relative the Common Buckthorn (*Rhamnus catharticus*). The former has rounded leaves with smooth edges; the berries, about the size of a pea, are borne singly, and are of a purple hue; further, the stems bear no thorns; but in the case of the latter the leaves are toothed, the berries are black and often clustered, whilst the twigs often end in a thorn.

From the crushed berries of the Common Buckthorn is prepared the syrup of Buckthorn—a medicine now but little used. A yellow dye is also made from the unripe berries. But it is for the entomologist that this shrub has special interest and attraction, on account of its being the food plant of the caterpillar of that beautiful sulphur-coloured butterfly, the Brimstone, an insect which delights the eyes of all who see it.

BENJAMIN HANLEY.

ALDER BUCKTHORN (IN FRUIT).

THE ROSE GARDEN

"A Garden of Roses is complete and fully satisfying"

By H. H. THOMAS

IT matters not how many kinds of flowers a garden may boast if Roses are absent; nor how few if Roses are among them. The former lacks the essential spirit of garden life, while the latter has little to gain by the inclusion of other blooms. Roses form, as it were, the corner-stone of the garden. If the foundation is laid with the queen of flowers, then the garden may extend its bounds away and beyond, stranger petals may flutter here and flutter there, for the heart of it all rests firm and sure amid the rich colour and sweet fragrance of the Roses. As a rule, every man begins to make a garden by planting Roses; he feels that with Roses wanting his garden would be as a country without its queen, elf-land without its fairies. There are few flowers with which alone a garden can be made, and among those few the Rose stands easily first. A garden of Roses is complete and fully satisfying. No flower is such a host in itself; not only does it possess the attributes of a perfect blossom, rich colour and fragrance, but for variety of form in leaf and flower it is unapproached. One may have Roses that grow only a foot or so high, others that throw their slender growths to a height of fifteen feet or more among the leafage of holly or the lichen-crested boughs of some aged orchard tree, and between the two extremes there is variety indescribable—and all of Roses.

A Rose garden of to-day is very different from that of ten years ago, owing chiefly to the remarkable progress made by workers among the flowers, whose lot it is to enrich our borders with Rose treasures that fall, as it were, from the lap of the gods. Progress has been most marked

among the climbing and creeping kinds. A generation ago Gloire de Dijon was looked upon as the typical Climbing Rose, and not only was no Rose garden complete without it, but there was none to usurp its place. One might say with much truth even now that Gloire de Dijon is well worthy of inclusion, for it is one of the earliest to open and one of the last to close. But it is a puny thing beside the luxuriant climbers which chiefly American rosarians have evolved from the dainty, pink and white flowered, almost evergreen Creeping Rose from Japan, and some of the large flowered kinds. They have made of our Rose gardens a rich feast of glowing colour, luxuriant bowers of glorious blossoms that hide the very shoots and leaves that gave them birth. The blooms come not in twos and threes, but in lax bunches, each of which is in itself a real bouquet. Their slender twining stems quickly cover the arch or arbour, pole or pillar that supports them, and their lustrous leafage alone is beautiful to look upon ; beautiful in early summer before the buds have burst to blossom ; beautiful still when the flowers have faded, for these newer Roses are almost evergreen. And best of all, perhaps they grow as only they know how to grow, and scorn the coaxing which the old Gloire de Dijon has so come to expect that now it cannot do without. And how they blossom ! As though the very world were one of bloom and they must lead the way.

Not only should the perfect Rose garden be full of Roses, but Roses must encompass it. Without—smothering all boundaries, festooning gateways, climbing into and hiding the base of neighbouring trees. Within—sheeting arbour and arch, bed and border and trellis with a wealth of fragrant bloom. A Rose garden must be a garden of Roses—of Roses and little else. We may, with propriety, allow the blue spires of Larkspur to rise here, and group the bounteous Pæony there, and among them all, hiding the bare soil beneath a lovely carpet of bloom, plant Pansies and White Arabis, Candytuft and Mignonette. But chiefly the Rose garden is to be a garden of Roses—Roses that clamber and climb and creep, Standard Roses, Dwarf Roses, Sweetbriar and China (and round about these a casual bush of Lavender and Rosemary), and all the other Roses, new and old, that are available to grace the garden of to-day. Roses, too, clambering over the porch and peeping in at the bedroom windows, Roses for edgings and Roses for hedges. Indispensable for planting without is the Musk Rose from far Himalaya, whose olive-grey leaves have almost as subtle a charm as the large, white fragrant flowers which the slender growths flaunt gracefully at a height of fifteen feet or so. There are few Roses to approach this for sheer vigour of growth, for luxuriance of leaf and blossom. Plant it fairly and well in soil made rich and firm, and in the course of a few fast-fleeting years, lo ! you have a giant in the Rose garden, that has thrown a screen of fragrant beauty across the face of the workaday world—the world outside the Roses—shutting out the world, shutting in the Roses. Yet how few grow this Rose. You may see it in the Dell at Kew, and in the gardens of peers and princes, but in countless others where it would thrive equally well it is not known. Yet the Musk Rose is democratic and not fastidious ; it will thrive in the public plot of the wayside cottage as finely as in the exclusive solitude of the lord's domain. For, like almost every other Rose, it is not magnificence it needs, but tender, kindly care. And what I have written of the Musk Rose is equally true of others—of others that clamber and climb. Start them well, plant them carefully in land enriched and well prepared, and there is no doubt of the result—a graceful thicket of growths that in due season glows beneath a canopy of leaves, bright, shining green, and finally sparkles like precious stones when the sunlight plays about its load of blossom. And for the names of some of the Roses that light up the garden in summer, and above all in early summer, with a radiance borrowed from fairyland ?

Here are a few of the best, and none, I think, were known or grown ten years ago. Dorothy Perkins and Lady Gay (pink) ; Blush Rambler ; Philadelphia Rambler (red) ; Wedding Bells (pink) ; Hiawatha (crimson and white) ; Tea Rambler (copper and pink shades) ; White

Dorothy Perkins; Papillon (pink and white). But the perfect Rose garden is not made with new Roses alone; some of the older sorts still hold their own. Such, for instance, as Reine Olga, which flaunts her giant crimson-scarlet petals in queenly fashion above large, bright green leaves; Aimée Vibert, almost the oldest and perhaps the best of the white-flowered Climbing Roses; William Allen Richardson, still unsurpassed for intense orange or apricot colouring; Reine Marie Henriette, commonly called the red Gloire de Dijon, and Crimson Rambler, still unapproached for rich and brilliant colour. One more to name and I have done with the Rambling Roses, the garden's fairest flowers, the embodiment of grace and live, luxuriant beauty. This one is something of an anomaly; it was raised in Switzerland, has a German name, Conrad F. Meyer, and is really of Japanese origin, for the thorny Japanese Briar is one of its parents. It grows vigorously, ten feet or more high, its shoots are armed with strong, stout spines, and it bears quite early in summer a burden of exquisitely formed and fragrant rose-pink blooms that would captivate the heart of the least impressionable, and win the whole-souled admiration of the most indifferent gardener. It is a Rose, that more perhaps than any other of recent introduction, has intensified the glamour that hovers about the court of the queen of flowers—in short, if I were Pagan, a Rose that I would worship.

Within the Rose garden Standard and Bush or Dwarf Roses are of chief importance. The Standard Rose has fallen on evil days in the twentieth century, and the reason is not far to seek. It failed to march with the times. With a few notable exceptions (one of which is shown in the accompanying illustration) Roses when grown as Standards became stunted, bare of leaf and sparse of blossom. The demand of the Rose lover of to-day is for free-growing sorts that smother their shoots in flowers, Roses that give prodigally in return for little expenditure. Consequently the Rose grower looks askance at the old-fashioned Standard. But its star is again shining; it has taken a new lease of life and, in a different form, is regaining the affection it went near to

A GARDEN OF PINK ROSES.

STANDARD ROSES IN JULY.

losing altogether. In its season a Standard Rose may be the most exquisite flower picture in the garden, or it may be, as often it is, one of the least attractive. But the Weeping Standard and the free-growing, in contradistinction to the "mop-headed" plants, are fast becoming popular, and soon they will compel greater admiration than the old Standard Rose did in its palmiest days. The true Weeping Rose, if not altogether a creation of the latter-day florist, owes its increasing popularity to his endeavours. Imagine a stem five or six feet high from the top of which depend gracefully and symmetrically long, slender growths that reach to the ground, crowned with lustrous leaves, studded with brilliant bloom, forming a perfect parasol of blossom. Fix in your mind's eye this exquisite portrayal of Rose beauty, and you have an impression of the rare and singular charm of the Weeping Standard Rose. It is unique; the garden contains nothing quite like it, and it has been made more characteristic still by the introduction of the new American-Japanese climbing varieties. They depend from the top of a Briar six feet high with as fine a grace, as subtle a charm, as they climb about the larch or oak pillars of a pergola. Ten years or so ago few thought of using the Climbing Rose as a standard; to-day it stands as the type that will save the standard from neglect and possibly oblivion. Such free-growing sorts as Crimson Rambler, W. A. Richardson, Gloire de Dijon, and other favourite climbers, make delightful standards. They do not form Weeping Standards like Dorothy Perkins, Hiawatha, and other extra vigorous Roses, but they are far more beautiful than the prim and proper specimens that were appraised so highly not very long ago, despite the fact that Dean Hole was never tired of condemning them. "Their appearance is unhappy," he wrote, "there is no congruity between stock and scion, no union between horse and rider—an exposition, on the contrary, of mutual discomfort as though the monkey were to mount the giraffe."

The Roses that fill the greater part of our gardens, with which we plant beds and borders, and upon which we rely for blooms of perfect form and exquisite colour

shades, and for fragrant petals, are Bush or Dwarf Roses, now to be obtained in hundreds if not in thousands of varieties. Dozens of new ones are sent out every year by professional growers, and last year alone nine survived the severest test of all, and received the gold medal of the National Rose Society. The profusion with which new Roses are now showered upon flower lovers is remarkable. Some have only a fleeting career; they flash in the firmament of Roses as meteors across the sky and are gone, to be seen or heard of no more; they were not so good as Roses already in cultivation. Others, more perhaps on account of their novelty than in virtue of any real merits they possess, shine brightly for a few seasons, but alas! they fail to live up to their reputation, and their light, too, goes out. Public opinion moulds the destiny of a new Rose. Let it be whispered that the colour is not pleasing, that its petals are ill-formed, that it lacks any one of those qualities which stand for birth and breeding, and not the greatest effort can avail to set up a new Rose on the pinnacle from which it has fallen. In many ways the newer sorts are a great improvement on the old ones; chiefly because they give us flowers in summer and autumn, while formerly we were well content to gather Rose buds in June and blossoms in July. Nowadays a carefully planted garden is gay from May until October. Most exquisite of the new Roses are those of yellow, apricot and old gold shades, such, for example, as Madame Ravary, Betty, Mme. Pierre Cochet, Harry Kirk and Souvenir de Pierre Notting. Those are among the most delightful Roses in cultivation, and some of them should be in every border. Our chief lament now is for crimson Roses that will bloom in autumn as well as in summer. In September our Rose buds are gay with blooms in white, pink, rose-pink, salmon-pink, and many other shades of pink, but the crimson Rose is conspicuous chiefly by its absence.

After all, the most treasured possession of our Rose garden, the characteristic that is of paramount value, is the quality of fragrance. We might dispense with perfectly formed petals in entrancing colour shades, with continuity of flowering and vigour of growth; all these are as nothing if in gaining them we lose fragrance, for this is the very soul of a garden of Roses. The glamour which invests its leaves and flowers is born of fragrance; in fragrance it must live, without sweet scent must die. Yet many of the new sorts which have come to stay are not sweet scented, and they deserve no place within the flower-embosomed gates of the garden of Roses.

H. H. Thomas.

SOME TYPES OF BIRDS' NESTS—II

By BENJAMIN HANLEY

With Photographs by the Author

PROBABLY a nesting ramble in a country lane yields the best results, for in such places there is usually to be found more variety than elsewhere. One can tell from the variety of bird voices heard that many kinds of nests are to be seen for the seeking.

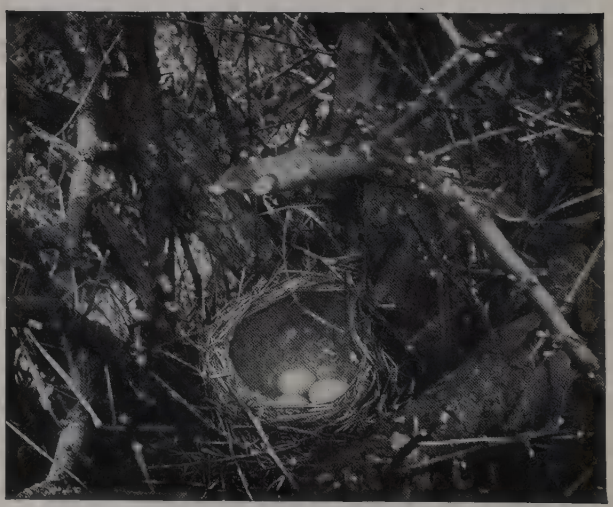
The Song Thrush fluently singing from the topmost branch of an oak tree is happy in the knowledge that somewhere deep down in the hedge beneath him his mate is safely covering her black-spotted turquoise-blue eggs in their cup-shaped resting-place; the Greenfinch swaying gently at the end of a twig monotonously "cheeing" to his sitting mate; the Black-

NEST OF BLACK-HEADED GULL.
Supposed abnormal clutch.

bird which flies silently from a bush and then cackles noisily after gaining a safe distance; the "chacking" of a Whitethroat as you approach that thicket; the scolding of the Sedge Warbler as you pass the tangled vegetation by the dyke side—all these, and more, tell of hidden homes and treasures dear to the hearts of each possessor. In such a place there are nests by the score—many Thrushes with young, some with full clutches, others yet in the "wet" or "ready" stages—to fall into the vocabulary of our school-days. Some of the Song Thrushes have already left their nest, and as you walk along the commotion of the old birds gives you the first clue to their whereabouts; then you hear a chirp from somewhere near, but although you look long and carefully no bird can be seen. When almost tired of looking the eye suddenly catches sight of it, and you think how conspicuous it is, and how absurd that it was not seen at once. But in all probability it is not in such a conspicuous position as one might hastily conclude. Leave it for a moment or two, then retrace your steps, and although the bird has not shifted its position in the least, one has the same difficulty in locating it as before—so much for protective resemblance, which, in this case, is well illustrated.

Of Blackbirds' nests there is no lack, and although the homely Hedge Sparrows are quite as plentiful, one does not find so many, for the majority are cunningly hidden behind some ivy-clad stump; but when even one is seen, with its dainty eggs of heaven's blue, one thinks that this surely is the prettiest egg of all. Somehow everyone seems to have a warm corner in his heart for our humble friend "Shuffle-wing," or "Cuddy" as the school lads call him. Soon from a bank side a Robin is seen to fly out, and on going to the spot the nest with its red-speckled eggs is soon discovered.

Perhaps we may stumble upon a young prodigal who, not content with his



NEST OF SONG THRUSH.

NEST OF ROBIN CONTAINING SIX WAGTAILS' AND FOUR ROBINS' EGGS.

A pair of each bird visited the nest, which was built by Robins.

surroundings, takes to exploration with disastrous results to himself. Here we may bring joy to his parents' hearts by restoring him to his family.

If we are fortunate another youngster—not a prodigal this time, but one might perhaps be justified in saying a glutton—a young Cuckoo filling, and often overfilling, its foster-parents' nest, sitting with gaping mouth all day long, thanklessly taking the dainty tit bits its devoted attendants so frequently bring; and yet its appetite remains insatiable. How many times a day must they feed that greedy mouth! They have apparently very little time to look to their own requirements.

Yonder is a cock Linnet resplendent in crimson breast and forehead. The nest, not built in a furze bush as is so often the case, but in a hawthorn hedge, is not difficult to find, and as the branches are slightly pulled to one side the eggs are seen: white faintly tinged with blue, spotted with reddish brown and purple. Only a few yards farther the same hedge yields another treasure, only much lower down this time, amongst the tangled vegetation—a Garden Warbler's home—with four muddy white eggs stained and spotted with light and dark greenish brown.

Farther on a hen Corn Bunting flies from her lowly nest on the ground and joins her mate sitting on the top of a gate, plaintively singing, leaving her eggs plain for us to view.

* * * * * *

During a nesting ramble one often happens upon nests built in curious or even unique situations, or possessing something unusual, and rendered especially interesting on that account. Such a one is the mixed nest of a Robin and Pied Wagtail here shown. It was found in the side of a haystack, and it would appear that the Robins were responsible for its formation, as the nest of the Wagtail is not usually so neat as this specimen. When discovered it contained two Robins' and two Wagtails' eggs, and a week later four Robins' and six Wagtails' eggs.

The eggs of the Robin may be distinguished in the photograph by their mottled appearance and more rounded shape. At first both pairs of birds visited the nest, the Wagtails coming on the scene as soon as it was built, and being the stronger birds eventually drove the Robins farther afield. Incubation was undertaken by the Wagtail, and it would have been very interesting to see how the "dish-washers"

NEST OF CORN BUNTING.

would have managed such a mixed family, but the inevitable small boy came along and appropriated both nest and eggs.

Contrary to what one might think, Moorhens frequently nest in trees or bushes. I have found them at various heights from three to twelve feet from the ground. The one found at a height of twelve feet was placed on the top of a Wood Pigeon's old nest. In such instances the young apparently must be carried down to the water by the parent birds.

The usual number of eggs in a Black-headed Gull's clutch is three, sometimes only two, but a few seasons ago I found two nests containing four each and one with five. These I thought were really remarkable, but later on I found the explanation rather disappointing, although at the same time delightfully simple. Some youths had been surprised whilst "collecting" at the gullery by the keeper, and, in their anxiety to get rid of the eggs in their possession, had hurriedly dropped more than the usual number into three nests. Needless to say, it does not do to take too much for granted. I may add that in each of these supposed abnormal clutches the eggs were safely hatched.

* * *

Still we might continue our way and see many more nests, some needing careful search so cunningly are they hidden, and others quite conspicuous, until we at length reach the highway once more with its noisy traffic and white, choking dust; but still we carry away pleasant recollections of what we have seen and heard in a leafy lane.

BENJAMIN HANLEY.

NEST OF GARDEN WARBLER.

CORNFIELD.

From the Water-Colour Drawing by C. E. Flower.

Photograph by P. Webster, Newcastle-on-Tyne.

PINNACLE ROCKS, FARNE ISLANDS.

HOW TO KNOW THE BIRDS

By the REV. MAURICE C. H. BIRD, M.A., M.B.O.U.

THE SWIMMERS—III

WHEREVER there are large ponds, lakes, or slowly flowing rivers, there the Little Grebe, or Dabchick, may be looked for. It is a very shy and silent bird, seldom rising from the water, but equally at home beneath the surface, rapidly disappearing from sight on the slightest alarm, and that without making a ripple on the water. Some twenty years ago, whilst shore-shooting on Canvey Island, Essex, I surprised a family party of five of these expert little divers—they are only about nine inches in length—on a small bare-edged pond, saw them all submerge themselves, watched that pond for nearly half an hour, but not one of them meanwhile revealed more than a beak tip!

The far larger Great Crested Grebe, and a much more imposing bird, especially in the breeding plumage, with horn-like ear tufts, and brown and chestnut ruffle, seems to be increasing its range, or at any rate increasing in numbers during the nesting season, since the passing of the Bird Protection Acts. It is rather more shy and wary than the Dabchick, but is not so silent, and therefore when once its harsh and loud call-note, "kur-ruk, kurruk," is known, attention is

Photograph by P. Webster, Newcastle-on-Tyne.
GUILLEMOTS.

called to the presence of a bird whose proximity would otherwise remain undetected. The "Loon" seldom seeks safety in flight, and when detected on the open water at some distance from the shore will often continue to swim rapidly away, incessantly turning its head from one side to another, so as to keep an eye upon its pursuer; but if your boat gains rapidly upon it, or the bird has approached within some ten or twenty yards of the reed-clad shore or sedge-encircled bank, it will dive at once—it never actually swims into hiding.

Both species build floating nests of semi-decayed vegetation, the mass being anchored to water plants, and constantly added to as incubation proceeds. The four to six eggs, dull white when first laid, are half buried in the surface of the almost flat nest, which is in fact a miniature hotbed. The parent bird always covers her treasures when leaving them, and the rapidity with which this can be done is truly marvellous. The nestlings are lovely little objects, with brown and white zebra-like markings and a pink patch on their foreheads. The stripes on body, neck and head soon disappear, but the succeeding down is retained until the young birds are more than three parts grown. On the wing the adults have a straight flight, generally only a few feet above the surface of the water, with outstretched neck and legs, and rapidly vibrating wings in which the white secondaries are conspicuous. There has recently been some correspondence in the natural history papers on the late nesting habits of this species; it is a mere question of local vegetation. On our Norfolk Broads the Great Crested Grebe is very early in commencing to breed. As the reeds are as a general rule only cut once in two years in the same place, the "Loons" can always find sufficient concealment somewhere as soon as nature suggests nesting.

The rock birds—Guillemot, Razorbill,

Photograph by Miss E. Shiffner, Lewes.
PUFFINS.

and Puffin—close-feathered, lumpy birds, feeding on fish, and carrying much fat, are each of them black above with white under-parts. The wings are short and pointed, reaching almost to the tip of the inconspicuous tail; the feet are webbed and set far back. All are gregarious at all seasons, and spend most of the time at sea. The first two are residents, but the Puffin winters further south. Guillemot and Razorbill are about eighteen and yellow skin at the gape allows the mandibles to be opened widely. The orbits and feet and legs are orange-red. A further peculiarity about this grotesque bird is that the basal covering of the beak is shed in the autumn. In common with the Guillemot and Razorbill it lays but one egg, which is of a dirty-white ground colour, very faintly marked with lilac; this is either deposited in a rabbit burrow or in a hole tunnelled out by the

Photograph by Miss E. Shiffner, Lewes.

SHAGS.

seventeen inches long respectively. The chief distinguishing mark between the two is the beak, which is black in both species, but that of the Guillemot is comparatively straight, pointed, and whole-coloured, whilst that of the Razorbill is arched, much compressed, and hooked at the tip, and has one, two, or three white transverse bars, according to age, on the upper mandible. There is also a white line extending from the base of the beak to the eye. The smaller Puffin, or Sea Parrot, has a white or smoky-white face and a very peculiarly coloured and distinctively shaped beak, shorter than the head, and very much arched, wider, or rather higher, than it is long, slaty grey in colour with orange-coloured ridges, and almost red tip. A patch of loose bird itself. The Razorbill lays its very handsome solitary egg—which is pyriform and whitish or pale brown in ground colour, blotched and spotted with various shades of deep rich brown, chiefly at the larger end—in close proximity to those belonging to other members of the colony, on the bare rock ledge, its shape being its only safeguard from being rolled into the sea or dashed on the rocks below, when the parent bird is frightened from it. But this provision of Nature reaches its greatest development in the blue-shelled, black-scrawled egg of the Guillemot, which is even more decidedly pear-shaped.

The chief difference between the Cormorant and Shag is in their size, the former being three feet in length, and the latter about eight inches less. Both

are almost entirely black, but the former is purplish black, and in the breeding season has a white chin, delicate white hairy feathers on the neck, and a large white thigh patch; whilst the Shag has rich dark green reflections, and a crest which curls forward at the back of the head, and no white about the body. A less obtrusive difference, but one constant at all seasons, is that of the Cormorant having fourteen tail feathers, and the more local Shag only twelve. Both birds build in colonies.

Photograph by P. Webster, Newcastle-on-Tyne.

RAZORBILLS.

The adult Gannet, or Solan Goose, is a purely maritime bird; large, as its secondary title suggests, its wings extend to six feet, though its length is only thirty-four inches. In full plumage the general body colour is white, with black feet and wing feathers. The head and neck are tinged with buff, and the bare skin at the base of the beak is dull blue. The first plumage, or rather the plumage of the first year, is almost black, with white spots—after the white nestling down is lost—the under-parts pale brown. It is not until the sixth season that the adult plumage is assumed. Never quitting the sea, except when storm driven, this bird is not likely to come under the observation of land-dwelling naturalists, but those whose business or pleasure takes them near its breeding haunts or fishing grounds will experience much pleasure in watching the tremendous plunges—generally successful—which this grand bird makes upon surface-swimming fish.

Of the Terns, or Sea Swallows, two species are fairly common summer migrants, the Common and the Lesser Tern; the Arctic also breeds sparingly in a few localities. All have been benefited by the Protection Acts. They are Gulls in miniature, with elongated wings and beaks and forked tails, the most graceful in form and flight of all sea birds, with black crowns, pearl-grey upper parts, and white below. Common and Arctic are inseparable as to size, the beak being the most distinctive feature. In the Common it is deep orange-red with a black tip, whilst that of the Arctic is blood-red throughout. In adults the tail feathers are longer and the *tarsi* shorter than in the Common species. The Lesser Tern has a yellow beak and orange-coloured legs. All three build in colonies, making but little nest on the sand or shingle and laying two or three eggs each.

Of the six commoner species of Gulls, the Great Black-backed is the most solitary and also the largest, measuring about thirty inches and having a wing spread of 5 ft. 9 in. The feet and legs of this bird are pale flesh colour, which fact alone will serve to separate it from the more frequent Lesser Black-backed, which has them yellow. It measures about twenty-two inches. Their black mantles mark them off from the other four species. The Herring Gull is only a trifle larger than the foregoing, but its lavender back distinguishes it from the adult Great Black-

Photograph by Miss E. Shiffner, Lewes.

BLACK-BACKED GULLS ON GANNET ISLAND.

Photograph by P. Webster, Newcastle-on-Tyne.

KITTIWAKES.

backed, and its flesh-coloured feet and legs mark it off from the Lesser Saddle-backed. In full plumage the whole head, tail and body colour of these three Gulls is white, as is also that of the Common Gull and Kittiwake, which, eighteen and sixteen inches long respectively, have both grey mantles, but the so-called Common Gull has greenish-yellow feet and legs, whilst those of the Kittiwake are dark brown ; from the absence or very rudimentary condition of the hind toe, this bird is scientifically known as the Three-toed Gull. The Black-headed, with deep coral-red feet and legs, is perhaps the most widely distributed of the species, and therefore more deserves the title of "Common" Gull ; moreover, its chocolate-coloured head in summer is only represented by a dark ear-patch in winter, at which season it straggles far from the coastline seeking worms and slugs and grubs from flooded pastures and freshly ploughed fields. On the wing it shows more white than any of the previous five. In all species the young are more or less marked with brown, and the tail feathers with black. Immature birds of the three first-named species are commonly mixed together as "Grey Gulls." In flight the adult Common Gull shows white tips to the primary flight feathers, whilst those of the Kittiwake are black throughout. A conspicuous white edge to the wing distinguishes the Black-headed, and in the hand the mouth and gape of the Common Gull will be seen to be lead-coloured, whilst that of the Kittiwake is vivid orange. MAURICE C. H. BIRD.

THE LIFE EPHEMERAL

THE MAY FLY AND ITS LITTLE DAY

By R. A. STAIG

OF summer and the flowing stream are the May Flies. Fragile creatures —how softly they settle, folding close their gauzy wings like a scintillating sail ; their slender bodies curving elegantly upward ; the long, delicate tail filaments waving to and fro.

They cast their eggs upon the waters, but the eggs are not swept away, for each one has minute knobbed threads which serve as anchors in the mud. Six or seven months may pass ere the larvules hatch out. Very slowly these tiny things grow, gradually becoming large-eyed nymphs with sheathed wings showing behind the head, and with two or three filiform tails, features suggestive of the future flying form. And the rows of little leaf-plates fringing their sides : these are not oars for swimming, but appliances for breathing, provided with air tubes, or tracheæ, by means of which the oxygen requisite for bodily aeration is extracted from the water.

Rounded in form and stout of limb are the nymphs that burrow in the oozy banks. The flat species are usually found in swift streams upon the under surfaces of submerged stones. They run rapidly and with a wriggling motion. Some kinds, which have the tails thickly set with cilia, swim freely. There are others that wander about covered with mud and are thus concealed.

Two years, more or less, these larval May Flies haunt the dark recesses of the streams, then suddenly comes the hour of their summer emergence to aerial life. They float on the surface, the skin of the back bursts open, and within ten seconds out comes the winged Ephemera and flies away.

When the skylark soars in the zenith of the heavens, carolling June-day vespers,

Photograph by Wm. Kinghorn, Glasgow.

ON THE LEFT IS THE "DRAKE" OR SUB-IMAGO OF *EPHEMERA VULGATA*, AND BELOW IT IS SHOWN ITS EXUVIA, THE MAY FLY "GHOST." ON THE RIGHT IS THE IMAGO OR PERFECT FORM OF *EPHEMERA VULGATA*.

down in the shady deeps of the troutpool the "speckly one" rouses himself from his late siesta—the lazy stretch, graceful withal; the back-watering, then the yawn prodigious, and off he fins to the eddying shallows—hungry, expectant.

While he drowsed in the pool myriads of May Flies left the water to change their birth robes hurriedly 'mid leaf and blossom. These are the "duns" and "drakes" of your enthusiastic angler. Thither they went to throw off the green for a lacery yet more dazzling, more resplendent. By the banks, upon grass stem and tree trunk, they hang their filmy cloaks. We call these May Fly "ghosts." Preparation for a brief hour of pleasure, for the giddy dance of love and death. Over the woodland stream gathers a living cloud, swirling deliriously, sparkling in all the transient glories of gossamer wing and flowing silken tail-plumes. Witness the hurried courtship; the embrace of a moment; the separation to die. The sudden agitation of the water seems to prophesy the tragedy; splash after splash, circle following circle—'tis the hungry rise of the "speckly one"; a rich feast, a tragic farewell!

The whirl subsides; the cloud thins and scatters as they hover out of life—the May Flies of an hour ago, those that escaped the sure suck of the lurking trout; those that were successful in their last act in life.

The tranquil stream is the cradle of the children they never live to see! Such is the life ephemeral, the maturity that lasteth but an evening!

R. A. STAIG.

Photograph by Wm. Kinghorn, Glasgow.

ON THE LEFT IS THE NYMPH OF THE MAY FLY *EPHEMERA VULGATA*, AND BESIDE IT IS ITS EXUVIA OR CAST-OFF SKIN. THE THREE SMALLER FORMS ARE THE FLAT NYMPHS OF THE MAY FLY *BÆTIS*.

HOW TO KNOW THE WILD FLOWERS

By the REV. H. PUREFOY FITZGERALD, F.L.S.
With Photographs by HENRY IRVING

THE FLOWERS OF THE CORNFIELDS

CORN MARIGOLD

ONE of the most conspicuous amongst the cornfield flowers is the yellow Ox-eye Daisy (*Chrysanthemum segetum*). It is a plant that cannot well be mistaken for anything else, the bright yellow, daisy-like flower, about two inches across, will be sufficient for its identification. The Marigold is a troublesome weed to the farmer, coming up, as it does very frequently, in large numbers amongst the corn. In height it is usually about twelve inches, sometimes more; the lower leaves are stalked, whilst the upper leaves clasp the stem, and generally they all have a few coarsely cut teeth at the top. An examination of the flower will soon reveal that the Marigold is one of the composite plants, in which the flowers consist of a large number of small florets collected into one head. This plant is to be found in flower from June to September. Another well-known member of the genus is the white Ox-eye Daisy (*Chrysanthemum leucanthemum*); this, however, has a far more extending range of growth. It is to be found chiefly growing in pastures or grassy banks, and in railway cuttings, and so cannot strictly be described as a cornfield flower. The florets of the ray in this species are white, and the disk only is yellow; the stems are hard and furrowed, while the leaves are narrow and coarsely toothed. In the north of England and Scotland the common Daisy is called the "Gowan" (signifying golden), and the Ox-eye Daisy is termed the "Horse gowan"; in England other common local

CORN MARIGOLD.

names are Dog Daisy, Moon Daisy, and Maudlin Daisy.

OX-EYE DAISY.

CHAMOMILE

Growing amongst the stubble, after the corn has been cut, and also in waste places, two or three other daisies may be found, the flowers of which resemble those of the Ox-eye, but are not quite so large, and the leaves are pinnate, with narrow lobes. It may be difficult to distinguish between these, as there are three or four plants, closely allied, and very similar in appearance. The Corn Chamomile (*Anthemis arvensis*) flowers from May to August or September, the plant is more or less covered with small silky hairs. The Stinking Mayweed (*Anthemis cotula*) has smooth leaves, which bear small glands secreting a very nasty smelling and acrid juice; the unpleasant smell that arises when the leaves are bruised will help to identify it. The Common Chamomile (*Anthemis nobilis*), on the other hand, emits a very pleasant scent when it is bruised. This is the plant that was formerly used very largely for medicinal purposes; Chamomile tea was—and is now with some country folk—a favourite remedy for indigestion.

The Scentless Mayweed (*Matricaria inodora*), another of these closely allied and very similar flowers, has its leaves much more finely cut than any of the others, and the flower head is generally larger.

CORNFLOWER

The Cornflower (*Centaurea cyanus*) is a well-known plant in gardens, with blue, pink or white flowers that may be relied on to reappear each year where it has once been planted, as it seeds in a prolific manner. In the cornfields the florets of the disk are small and purple in colour, whilst those of the outer rays are fewer but larger, and of a brilliant blue. The plant grows to the height of about two feet, with single flower heads at the ends of long stems; these latter are very tough and wiry, are slightly angular in shape, and covered with a cottony down. Their wiriness is the origin of the local name "Hurt-sickle"; another common name is the "Corn Blue-bottle," the blue coming from the bright colour of the flower, and the term "bottle" because of a somewhat fancied resemblance of the scaly involucre just below the florets to a bottle or flask. The upper leaves of the Cornflower are arranged alternately on the stems, and are long, narrow, and with entire edges, coated with a downy substance; the lower leaves are broader and very often have somewhat rough toothed edges. The flowers may be found in the cornfields from July to September; it cannot be called a very common plant, as it is somewhat local.

CORNFLOWER.

THE POPPY

The flowers of the cornfields provide representatives of the three primary colours. The Cornflower gives us the blue, the Marigold the yellow, whilst the Poppy is of a brilliant rich scarlet. It sometimes grows so profusely that acres of fields, from a little distance, appear of this intense colour in June and July. The Corn Poppy (*Papaver Rhœas*) is an erect annual, frequently nearly two feet in height, with firm stems covered with stiff hairs; the lower leaves are large and graceful in form, with long stalks; the upper leaves appear on the stems with no stalks. Each of the four petals has a dark purple spot, or eye, at the base, and all are very delicate in texture; whilst in the bud the flower heads are bent over and the petals are tightly curled up and entirely covered by the two sepals of the calyx. These separate as the flower begins to expand, and finally fall off altogether. The Poppy does not secrete any honey, but insects are attracted by the quantity of pollen contained in the numerous stamens which form a dark ring round the pistil. This latter is a very conspicuous object in the centre of the flower, being crowned by a disk from which the stigmas radiate from the centre. This forms a very convenient platform for insects to alight upon, and if they have previously visited another Poppy flower and have been dusted by the pollen, some of this is sure to be transferred to the stigmas, and so effect cross-fertilisation. The fruit is globular in shape, and the seeds, which are very numerous, escape from small openings which appear in due time beneath the stigmas. All members of the Poppy family secrete a milky, syrupy liquid, which is more or less narcotic in nature; the species which provides the Poppy heads used for fomentations is the same as that from which opium is extracted (*Papaver somniferum*).

THE BINDWEED

The Corn Convolvulus, or Bindweed (*Convolvulus arvensis*), is a most troublesome weed to farmers, for the roots go very deeply into the soil and spread rapidly, so that it is a very difficult plant to exterminate. The name comes from the Latin *convolvo*, meaning "I twine around," as the whole plant twists itself round any slender support that happens to be near it. The flowering period extends from June till well on in the autumn. The petals vary in colour, being white with pink veins, or wholly pink. They are very sensitive to light and warmth, expanding rapidly when the conditions are favourable, but closing when picked. The flowers secrete a large amount of honey at the base of the stamens, which are slightly flattened out, so that the bee can only reach the honey by pushing its proboscis well down between them. In the act of doing this it comes in contact first with the stigma and then

with the anthers, so that the pollen which adheres to it on a visit to one flower will only be transferred to the stigma of the next which is visited.

CORN BIRD'S-EYE

The bright blue Speedwell, or Bird's-Eye, which grows in the cornfields is *Veronica agrestis*. It is to be found in most waste, and also cultivated places. Another species which resembles it closely, except that it is much larger in all its parts and of almost a brighter blue, is Buxbaum's Speedwell (*Veronica Buxbaumii*), which is not really a native plant, but it has spread very widely. The corolla of all the members of this genus consists of four petals, two large and two small, and it falls off, in one piece, almost as soon as the plant is shaken or picked.

FLAX

It is curious that the cornfields provide us with so many blue flowers—the colour that is most uncommon. The Flax, or Linseed (*Linum usitatissimum*), is another instance. It is not a true native of this country, but it has spread rapidly. The Flax is a very graceful, slender plant, quite smooth in appearance and branching towards the top; the leaves are found alternately up the stem, whilst the flowers are in a loose corymb; that is to say, the flower stalks start from different places up the stem, but the flower heads are all on the same level.

THE PANSY

The Wild Heartsease, or Pansy (*Viola tricolor*), is the parent of all the beautiful garden varieties now in cultivation. It is to be found elsewhere

SCARLET POPPY.

FLAX.

than in the cornfields, and wherever it appears is always welcome. The colour is very variable, being either purple, whitish or yellow, or even a mixture of all these. The shape of the flower will at once mark it as being one of the Violet family, and the general arrangement, which is somewhat of a complicated nature, ensures that it cannot be fertilised by its own pollen, insect visitation being necessary. This plant is very variable in its habit of growth. The name Heartsease was originally applied to the Wallflower, a certain medicine being made from these plants for heart affections, and Prior asserts that as the Pansy and Wallflower were both included among the Violets, it is easy to see that the name was transferred from the one to the other. The same author states that the origin of the name Pansy is obscure, and also gives many curious local names for the plant, such as Herb Trinity (from the three colours being often found in the same blossom), Cull-me, Love-in-idleness, Kiss-me-at-the-garden-gate, all of which are suggested by the coquettish hanging flower, with its half hidden face.

H. PUREFOY FITZGERALD.

BINDWEED, OR CORN CONVOLVULUS.

THE SPECIAL PROTECTIVE RESEMBLANCE OF GEOMETER CATERPILLARS TO TWIGS.

Two of their silken threads—they use these as stay-ropes when resting—can be seen between the two main branches.

BRITISH INSECTS

Some Notes on their Forms and Colours

By DOUGLAS ENGLISH, B.A., F.R.P.S.

With Photographs by the Author

IT is, I imagine, generally supposed that we have no native insects which can compare either in brilliancy of colouring, in quaintness of form, or in perfection of defence, with the insects which are peculiar to tropical countries. This view is unduly pessimistic. One need only use a sweep-net in May or June to discover that the supposed inferiority of our native insects is merely an inferiority in size. One need only employ a pocket lens on the produce of the sweep-net to realise that we have in every field and wood, aye, and in every patch of grass, a supply of grotesque forms, of brilliant colourings, and of marvellous adaptations, which is practically inexhaustible. Let the reader, who has not already done so, suitably illuminate and examine one of the emerald or turquoise Weevils which swarm on the whitethorn in June; let him feast his eyes on a scarlet-clad Hemipteron, or on that exquisite little Tortoise Beetle, whose wing-covers are banded with gold-green ribbons and edged with sea-shell pink; let him study one of the lilliputian Moths, those wisps of fluff and spangle, which flit from leaf to leaf of every hedgerow—and he must assuredly admit that the museums have nothing more beautiful to show him. Nor need he confine himself to microscopic forms. Let him consider such resplendent British insects as the Tiger and the Rosechafer among Beetles, the Sulphur and the Peacock among Butterflies, the Hoverflies generally, the Dragon-flies, and, perhaps most brilliant of all, that small but matchless Hymenopteron *Chrysis ignita*—the "Fire of Gold."

That brilliancy of colouring must serve some purpose in Nature's economy is certain, but there is no certainty as to

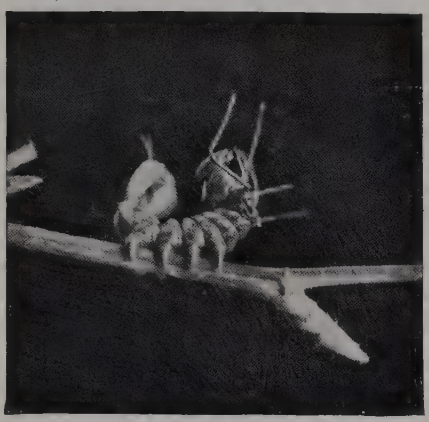
A REMARKABLE INSTANCE OF AGGRESSIVE MIMICRY (ALLURING COLOURS), AFFORDED BY A SPIDER OF THE GENUS *THOMISUS*.

This spider mimics both in colour and form the unopened bud of the bramble.

the precise benefit which any particular colour-brilliancy confers on any particular insect. A sombre habit, which harmonises so closely with the insect's normal surroundings as to make it practically invisible at rest, may be explained as a result of natural selection. Insects which are so protectively coloured as ordinarily to escape the notice of their enemies, must, we imagine, have a better chance of survival than insects which are markedly conspicuous. If we are right in assuming that dull-coloured insects have been benefited in the struggle for existence by their invisibility, we must also be right in assuming that brilliantly coloured insects have been prejudiced by their visibility, and we must, in their case, look for some additional means of defence which has enabled them to survive in spite of a severe handicap. The theory of "warning colours" though it cannot be said to resolve the difficulty completely—the final word must come from observers in the field rather than from experimenters in the vivarium—has at least furnished us with a useful working hypothesis. According to this theory a brilliant colour scheme (the black and yellow banding of the Wasp for example) is associated with some noxious quality (the Wasp's sting in this instance), and *serves to advertise the existence of that quality to all whom it may concern.*

At first sight it would appear that "warning" colours can only benefit the prospective enemy, and that they cannot therefore in any sense be the result of

natural selection. It has been argued, however, that though the individual conspicuous insect may be martyred on occasion by reason of his conspicuousness, his martyrdom must be regarded as highly advantageous to his relations. A young bird or lizard, for example, may, and probably does, in the callow stage sample Wasps and yellow-and-black Caterpillars. The sting of the former, however, and the nauseous taste of the latter, linger in his memory, and four or five experiments determine him to avoid yellow-and-black victuals altogether. Were Wasps and, say, Cinnabar Caterpillars protectively coloured, the young bird or lizard would, for the want of any means of distinguishing them from wholesome food, continue to be stung and to be made sick, both to his own disadvantage and to the disadvantage of Wasps and of Cinnabar Caterpillars generally. Though black in combination with red-brown, yellow, or orange is the most obvious form of "warning" coloration, it must be remembered that the theoretical purpose of "warning" colours is a conspicuous advertisement of the owner's disagreeable qualities, and that this advertisement may be effected by any colour, or by any form, which is markedly dissimilar from, and so markedly in contrast with, its normal surroundings. The whiteness, therefore, of White Butterflies, the metallic patches on many chrysalides, the aggressive hairiness of "Woolly Bears," and the devil-may-care publicity of gregarious Caterpillars, may each and all be danger signals.



TWO REMARKABLE DEFENSIVE ATTITUDES ADOPTED BY BRITISH CATERPILLARS.

1. The Puss Moth Caterpillar extruding filaments from the projections on the hind part of his body, and telescoping his front segments to show his eye-markings.
2. The Lobster Moth Caterpillar, mimicking spider.

It is a matter of some difficulty for the field naturalist to reconcile his own experience with the experimental proofs of the warning colour theory which have been conducted in the vivarium. He has seen Ichneumon Flies attack brilliantly coloured Caterpillars in the open; he has seen birds and lizards eat black and yellow insects, not with "evident signs of disgust," but with evident signs of satisfaction. He knows that the most flamboyant combinations of colour vanish amid suitable surroundings; that they are on occasion at least as protective as sombre colours; and that their protective character is due to their brilliance. Experience has taught him that in his own quest for food he conforms to definite conventions — he would have to be extremely hungry, for example, before he ate a sandwich which he found lying in the road—and he is inclined to suppose that insectivores among the lower orders may perhaps have conventions of their own, which make them diffident of eating anything, no matter what its colour is, which is not in such a situation as their food is usually found in, or behaving in such a way as their food usually behaves. This, in his judgment, accounts sufficiently for the fact that birds who are accustomed to hunt for caterpillars under leaves, look askance at an assemblage of Cinnabar Caterpillars naked and unashamed on

defoliated ragwort; and that Sand Wasps, who have had their paralysed prey taken away from them, will often give themselves the trouble of finding a fresh victim rather than recapture one which now shows none of the conventional signs of resentment, and must therefore be regarded as sick and unfit for Wasp consumption. The field naturalist, then, is likely to acquire the conviction that, given harmonious surroundings, any colour or combination of colours may be protective, while, if the surroundings are not harmonious, any colour or combination of colours may be conspicuous; and he will account for the persistence and comparative immunity of brightly coloured insects which expose themselves freely, by arguing that the immunity may be closely connected with the exposure itself, since insectivores generally show marked preferences as to the kind of food they wish to find and as to how they wish to find it. It is noticeable in this connection that the chief enemies to wasp-like Flies are the Wasps themselves, who frequently take them on the wing, but who seldom, as far as my own experience goes, take them when settled and at rest.

A TYPICAL BRITISH *VANESSA*, THE PEACOCK BUTTERFLY, WHOSE WINGS ARE WARNINGLY COLOURED ON THE UPPER AND PROTECTIVELY COLOURED ON THE UNDER SURFACE.

Warning colours appear to afford but little protection to such of our bright-hued insects as survive the winter. The queens of the social Bees and Wasps select not only sheltered but concealed situations to lie up in. The wings of our hibernating Butterflies are almost without exception "warningly" coloured on the upper surface, and protectively coloured on the under surface. It is the latter surface only which is exposed while they are hibernating. In most Butterflies one can trace on the under surface of each lower wing a tendency for the darkest portion to be nearest the insect's body, and for the remainder of the wing to be broken up with transverse ribbon markings across the centre, and chequerings on the outer border. The result of this arrangement is that with a suitable background the external outline of the wing is lost altogether. There is, in fact, an imperceptible softening away of the wing from the portion nearest the body outwards, while the body itself, which in the normal sleeping position is uppermost, is in most cases in the shadow of the support to which the insect is clinging. One can hardly doubt that the exceptional coloration of the under surface of the wings of the Large Copper (there was a broad warning orange band close to the outer border and following its contour) may have helped towards this handsome insect's extinction.

Though the theory of warning colours cannot be said to have won universal acceptance, it has nevertheless compelled universal attention, and mention must be made of a variation of it, which is due to Dr. Eisig. As the result of his investigations in connection with a small

group of Marine Worms, this biologist holds that brilliant pigmentary colours are the *cause* of the unpalatability of certain species, and that therefore they cannot have been evolved as an advertisement of that unpalatability, though they may, in time, have come to act as an advertisement. It is conceivable that not only pigmentary colours (orange, brown and black mostly) but also structural colours (metallic blues and greens mostly) may have their origin in some form of excretion, and on this ground Dr. Eisig's emendation of the original theory has gained considerable support.

TWO EXAMPLES OF PROTECTIVE MIMICRY IN THE FORM OF EYE-MARKINGS.

1. The female Emperor Moth. 2. The Caterpillar of the Large Elephant Hawk-Moth. The latter when alarmed retracts the front segments which carry the true eyes, and assumes the terrifying appearance seen in the picture.

One thing seems indisputable—that non-sexual brilliancy of insect colouring, whatever purpose it may be serving at the present, must have long since disappeared if it had not served some definite purpose in the past. This being so, we can, whatever be our opinions as to the exact meaning of non-sexual brilliance, admire without misgiving the fascinating theory of "protective mimicry." It is unfortunate that in natural history the word "mimicry" should have acquired a restricted meaning. It is a word which has no convenient synonym, and whose connotation should have been left wide. It might have embraced, to the convenience of reader and writer alike, all such natural simulations and dissimulations, special and general, constant and variable, as enable living organisms to appear to be what they are not.

"Protective" mimicry, however, was the term employed by Bates in his classical paper contributed to the Linnean Society's transactions in 1862, to denote such simulations of shape and colour as enable a harmless unprotected form of life to derive advantage in the struggle for existence from its resemblance to a harmful or protected form. Strictly speaking, then, "protective mimicry" is a highly specialised branch of that protective resemblance to surroundings which influences the whole existence of the lower orders, and which forms their most powerful weapon.

In the same way "aggressive mimicry" is a highly specialised branch of what is termed "aggressive resemblance." For a full understanding of the modern classification of protective and aggressive resemblances in Nature I must refer the reader to such a book as Poulton's "The Colours of Animals," and I must content myself here with a brief résumé of this classification, and with a few comments on the photographs which I have selected as illustrations of it. It should perhaps be pointed out that, as far as protective or aggressive resemblance is concerned, it is of the essence of a good photograph that it should be something in the nature of a puzzle picture. Professor Poulton defines protective resemblance as "concealment as a protection against enemies," and subdivides it into general and special protective resemblance. The former is a colour protection only, while, in the latter, form as well as colour are

embodied; either may be constant or variable. I have already given examples of constant protective resemblance in the case of the under surfaces of Butterflies' wings, and I need not dwell further on this subdivision. Good examples of variable protective resemblance are to be found amongst vertebrates. The Chameleon is perhaps the most notorious, but most fish and amphibians exhibit the power of varying in tint so as to conform to their immediate surroundings, and many northern animals change colour with the season. In the case of insects it is the Lepidoptera which have been chiefly studied. There appears to be no certain case of a Moth or Butterfly changing its skin, or its spots, after it has once reached the imago stage, but in the larvæ of Lepidoptera, and in such pupæ as are exposed to the light of day, variation to suit a change of environment is extremely common. Where protective resemblance becomes so specialised as to include form as well as colour, the insects provide us with unique examples, but the greatest care must be exercised to prevent our enthusiasm outrunning our discretion in considering what is or is not a true example of such specialised resemblance. In such cases as the Geometer caterpillars, and the caterpillar and chrysalis of the Purple Emperor, it cannot be reasonably doubted that there is a distinct and specialised resemblance between the insect and a portion of its natural food plant, but in the case of the Orange-tip Butterfly, whose exquisitely chequered wings have led to its being depicted times out of number asleep on the Wild Parsley, I venture to submit that beyond a coincidence of form and colouring there is no evidence whatever to establish the connection. The umbelliferous plants are singularly attractive to Flies and day-flying Beetles, and singularly unattractive to Lepidoptera. The pattern of the under surface of an Orange-tip's lower wings would conceal it in almost any outdoor situation. I would say much the same of the Brimstone's wings, though I am free to confess that the resemblance between the Brimstone asleep and a young holly leaf is, as has been pointed out by Mr. Kay Robinson, a remarkable one.

The most amazing forms, however, of specialised protective resemblance come under the heading of protective mimicry. One can hardly help regarding protective mimicry as an immoral phenomenon. It is so hopelessly commercial. It is as though one donned a policeman's uniform in order to stand in front of the crowd. The most evident examples of noxious insects in this country are the Stinging Hymenoptera, and there are countless stingless insects which mimic Wasps and Bees, both in coloration and in form. Humble-bee Flies, for example (*Bombyliidæ*), are familiar enough to those who study the woods. They are early, short-lived insects (May-June), and may be seen hovering with a characteristic and unmistakable flight—I have been told that it closely resembles that of a humming-bird, and that the illusion is helped by the length of the fly's proboscis—over some particular patch of ground which takes their fancy. To this they return again and again. In spite, therefore, of the enormous speed and decision with which they change course—I have seen one describe a complete circle flying inside a 1½-inch pill-box—they are easily caught. On examining them in the hand, one is at once struck by their flimsiness. Their legs seem hardly to support them, and their weak-kneed appearance is singularly out of keeping with the impression of strength and fussiness which one gathers from observing them in flight. Before rising in the air Bombylius brings his wings into action by a curious manœuvre. He deflects them suddenly at right angles to their position of rest and imparts to them an extremely rapid up-and-down movement. Viewed from above at this stage they present the appearance of two rigid black bristles, and are practically invisible against a dark background. As he warms to his work, the extremities of his wings vibrate in "figures-of-eight" in front and in rear of the perpendicular plane, and give one the impression of "buzzing." It is to their fussiness, I fancy, rather than to their colouring that the Humble-bee Flies owe their popular title. So far as colouring is concerned a far closer approach to the Humble-bees is afforded by Flies of the genus *Volucella*. These have no long

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EXAMPLES OF THE PROTECTIVE MIMICRY OF STINGING HYMENOPTERA BY VARIOUS ORDERS OF BRITISH INSECTS.

1, 2. The Humble-bee Fly *Bombylius* (mimicry of Bee).
3. A Smooth-bodied Fly, *Volucella inanis* (mimicry of Wasp).
4. A Smooth-bodied Fly, *Syrphus* (mimicry of Wasp).
5. The Wasp Beetle *C. arietis* (mimicry of Wasp).
6, 7. The Hornet Clear Wing Moth (mimicry of Hornet).
8. A Hairy-bodied Fly, *Volucella* (mimicry of Humble-bee).
9. A Large Saw Fly, *Sirex gigas* (mimicry of Hornet).

proboscis, and are built on stronger lines than the *Bombyliidæ*. Unlike the latter, they frequently settle. Their resemblance of certain species to the Humble-bees, both in furriness of body and in colour arrangement, is remarkable. Some are clothed with red hair at the extremity of the abdomen, and so mimic *Bombus lapidarius*, the common Fire-tailed Humble-bee; others are banded with sulphur yellow and so resemble *Bombus terrestris* or *Bombus lucorum*. Smooth-bodied *Volucellæ* often resemble Wasps, *V. inanis* being a good example. We shall recur later to the fact that in *Volucellæ* the mimicry is not only protective, but aggressive.

AN OFTEN QUOTED EXAMPLE OF "WARNING COLORATION."

The black-and-yellow caterpillar of the Cinnabar Moth on its food-plant Ragwort.

To turn for a moment to other orders of insects we find instances of a presumably beneficial protective mimicry in the Clear Wing Moths—I give illustrations of the Hornet Clear Wing—and in several Beetles, notably the common Wasp Beetle (*C. arietis*), who, as Professor Poulton has pointed out, exhibits, in addition to wasp-coloration on the body, a decidedly waspish character in the shape and movements of the legs. In all the above instances the simulation is of stinging Hymenoptera, but protective mimicry has an almost unlimited range, and may exist between creatures not only of different orders, but of different classes and even of different sub-kingdoms. Eye-markings are a case in point, and I would leave my illustrations to give some idea of the terrifying aspect which these harmless arrangements of colour can produce, more especially when, as in the case of many Caterpillars, they are combined with snake-like attitudes. It would appear that the suggestion is that there lurks behind the "eyes" a vertebrate body of a size to correspond with them. Spiders, again, and Ants, appear to be in themselves such effective "bogies," as to deserve the closest possible imitation in form. The caterpillar of the Lobster Moth on hatching from the egg closely resembles an ant. When full fed his terrifying attitude—he throws back his head and brandishes four skinny legs—bears an extraordinary resemblance to a spider, and, it can hardly be doubted, must often intimidate an Ichneumon Fly.

From protective resemblance, which, strictly speaking, merely effects concealment, we pass through its specialised form "protective mimicry," which deceptively suggests danger, to aggressive resemblance, defined by Professor Poulton as "concealment in order to effect attack," and to its offshoot "aggressive mimicry." Under the latter heading come appearances which "deceptively suggest some object attractive to prey (alluring colours), or which enable an enemy to approach without exciting suspicion (aggressive mimicry proper)." I am pleased to be able to present an example of "alluring colours," which I believe has not hitherto been published, in the case of a Spider of the genus *Thomisus*. This Spider (*T. citreus*) often mimics to a nicety both in form and colour the buds of the bramble, and the fly seen in some of the illustrations had, immediately before the photograph was taken, actually perched on the back of "his bitterest foe," but had found him inedible. Of aggressive mimicry proper we have an excellent example in the *Volucellæ* already referred to, whose wonderful simulation of Humble-bees enables them to enter the nests of the latter and deposit their eggs there. Their larvæ feed on the food stored by the Bees, or even upon the Bee larvæ. *Volucella inanis* is said to have similar designs on Wasps' nests.

THE BROOKLIME AND THE MINT.

CHAPTERS IN PLANT LIFE

VI—THE PLANT AND ITS ENEMIES

By S. LEONARD BASTIN

With Photographs by the Author

NATURE is, often enough, careless as to the fate of the individual, provided the perpetuation of the race is well assured. There are few instances in which this is so well seen as in the case of many of our common weeds. A considerable number of these species are peculiarly liable to the attacks of animals from which they seem to be ill-protected, yet these plants are always to be found in the greatest abundance. As a matter of fact, the race persists in flourishing, either by sheer vigour of growth or owing to the ease with which the species can reproduce its kind. The amazing vitality of the grasses is an excellent illustration of those plants which within reasonable limits are almost indestructible. For ages the grasses have served as the mainstay of the grazing animals, yet there are few more prosperous species. From the underground stems which so many of these plants produce, a constant supply of green tufts can be sent up to replace those which have been torn away. In the case of the Groundsel or Chickweed the continuance of the race is assured by the facility with which the little plant can reproduce its kind. Both these species seem to be harmless and sweet-tasting, such as the larvæ of insects, as well as snails and slugs, would delight to feed upon. Yet it is well known that these plants are among the most troublesome pests of our gardens. This is simply owing to the fact that both the Groundsel and the Chickweed come to maturity so quickly, that it is not an uncommon thing for several generations to be brought to perfection in a single season.

The entire animal kingdom lives at the expense of the vegetable world, and to protect the plant against the aggressors

CACTUS THORN.

many remarkable devices have been called into being. One of the most widespread contrivances for the defence of the plant is the thorn. These spines are very prevalent among many genera, and in the different species represent modifications of both leaves and stems. The development of the thorn is seen to a remarkable extent in the case of the Cacti, plants which in some ways are more perfectly protected than any others in the world. With many species, particularly among the groups Echinocactus and Melocactus, the whole plant is covered with spines, which interlace in such a way that no part is left unshielded. A kind of Prickly Pear, well named *Opuntia formidabilis*, produces thorns which are sometimes as much as a foot in length. The desert in which these plants grow is peopled with a comparatively sparse vegetation, and the juicy stems of the plants would be peculiarly liable to be attacked by hungry and thirsty animals. Indeed, even with its armament of thorns, the Cactus is not absolutely secure. It is said that the Mexican ponies have learnt the art of kicking away the spines with their heels, and then slaking their thirst at the bleeding wounds inflicted.

It is a very significant circumstance that the production of spines seems to take place to the greatest extent when the plant is growing under adverse conditions. In this connection an exceedingly interesting species is the Rest Harrow (*Ononis arvensis*). As is well known, this plant is to be found fairly common in two varieties, called respectively *O. spinosa* and *O. inermis*. As is implied by the name, one plant is thorny and the other is quite devoid of any spines. Now and again both these varieties may be found growing in the same district, sometimes quite close to one another. It will be seen, however, that the thornless specimen has been more fortunate in its position than the one which is well clad with its defensive armament. In the former instance the little plant has lighted upon a patch of moist, rich soil; whilst in the latter case a hard struggle for existence, in a dry situation, has been the fate of the subject. It is very commonly to be seen that a race of one-time thorny plants will, under cultivation, tend to get away more and more from their spiny character. As domestic subjects, the plants, removed from the fierce fight in the natural world, are no longer in need of protective devices.

Although in many cases serving the same purpose, the prickles often seen upon the leaves and stems of plants are on different lines from thorns, seeing that they are merely excrescences of the cuticle. The hooked prickles of the Briar Rose peel off with the skin and are quite unattached to the woody portion of the stem. In the Holly, the prickles are to be found springing from the margin of the leaves. It is curious that it is only whilst the Holly is in its shrubby form that the leaves evidence their prickly nature. As soon as the plant attains to the dignity of a tree the foliage is produced with its margins quite unbroken. In many large bushes, it is possible to trace the process by which the prickles have been gradually discarded; and from a single shrub an interesting series of leaves may be

gathered, commencing with the specimens from the lower branches, which are fully armed, and ending with those from the uppermost shoots, which are quite destitute of any prickles. As in the case of the thorny plants, it is to be noticed that prickles are produced in the greatest abundance when the specimen is having a hard time of it. Thus Briar Roses which have been cut back in hedges send up their fresh shoots abundantly supplied with prickles.

Closely allied to the prickles are the various hairy appendages which are so often distributed over the foliage of plants. The leaves of the Orange Hawkweed, and even the flower stems, are covered with stiff black hairs. Plants protected in this manner are not subject to the attacks of insect larvæ, slugs or snails, as would be the case if the foliage were perfectly plain. Similarly, grazing animals are less inclined to regale themselves on leaves which are thickly covered with bristles.

There must be few people who have not suffered at one time or another through coming into contact with the stinging hairs of the Nettle. Under the microscope it is seen that these stings consist of a long tapering cell, rising from a cushion-like base. The point of the hairs is easily broken, owing to the cell wall being very thin. When the hair comes in contact with any object which the apex can pierce, a slight wound is made, and at the same time the upper part of the bristle breaks, allowing the fluid which the cell contains to escape into the opening. The poison, consisting as it does of formic acid and a property known as enzyme, is of a peculiarly irritating nature—as most people will have experienced to their cost.

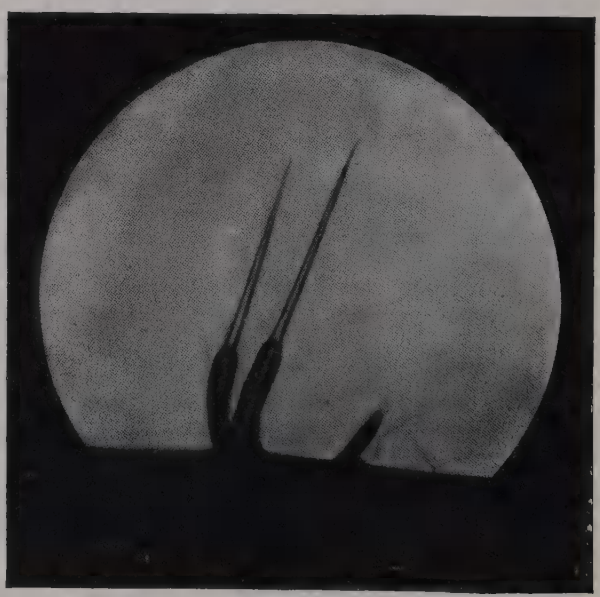
Far more formidable, however, are the stings of certain exotic species, one of which, the great Shrubby Nettle (*Urtica crenulata*) of Northern India, is a really formidable plant. This species attains

INK-BOTTLE OR URN-SHAPED FLOWER OF THE WHORTLEBERRY, ESPECIALLY DESIGNED TO EXCLUDE CREEPING INSECTS.

to the height of fifteen feet, and is described by Sir Joseph Hooker as having broad glossy leaves covered with microscopic hairs. The plant only seems to sting violently in the autumn, but at that time the strength of the poison is such that people have suffered from its effects for days. Moreover, at the time of its greatest activity the plant gives off an effluvia which is so powerful that it causes running from the eyes and nose. More formidable still is the *Urtica gigantea* of Australia, which grows into huge bushes twenty feet or more in circumference. It has been pointed out by Mr. Edward Step that in the foliage of the Common Elm very similar processes to the stinging hairs of the Nettle are to be observed. These are nothing like so formidable as those of the Nettle, but are sufficiently so to cause an annoying irritation to the hands. Of course, the Elm is classed with the same natural order as the Nettle. It seems likely that these stinging hairs serve a real purpose in protecting the young growths of the Elm just at a time when they would be most likely to be damaged by grazing animals.

A singular development is that to be seen in the case of the Cuckoo Pint (*Arum maculatum*). In this case the tissue of the foliage contains thousands of little crystal needles (in addition to a certain acrid poison) which stick into the lips, causing an intolerable burning sensation. This fact may be proved by anyone biting a small portion of the leaf. Whether these crystals are really a protective measure or not, there is no doubt that the plant must often be left alone on account of their presence. The crystals are developed to a much greater extent in the case of certain tropical plants allied to the Arum.

There is little doubt that the development of sour and poisonous juices in certain plants is valuable as a protective measure. This is not invariably so, for certain products such as the tannin in the Oak are merely waste products—the outcome of a definite chemical process. Still, in the case of many species it is clear that the plant derives a distinct advantage from its offensive juice, and we can hardly regard its presence as entirely accidental. If we take the strong-tasting plants of the countryside—the aromatic Mint, the pungent Water Cress, the evil-smelling Jack-in-the-hedge, to mention only three examples—we shall assuredly find that these species enjoy a comparative immunity from attack. True enough, as if by way of retaliation, certain insect larvæ seem to have developed a special fancy for some of these species ; but, as a rule, the mild-tasting vegetation is much more likely to receive the attentions of marauders.

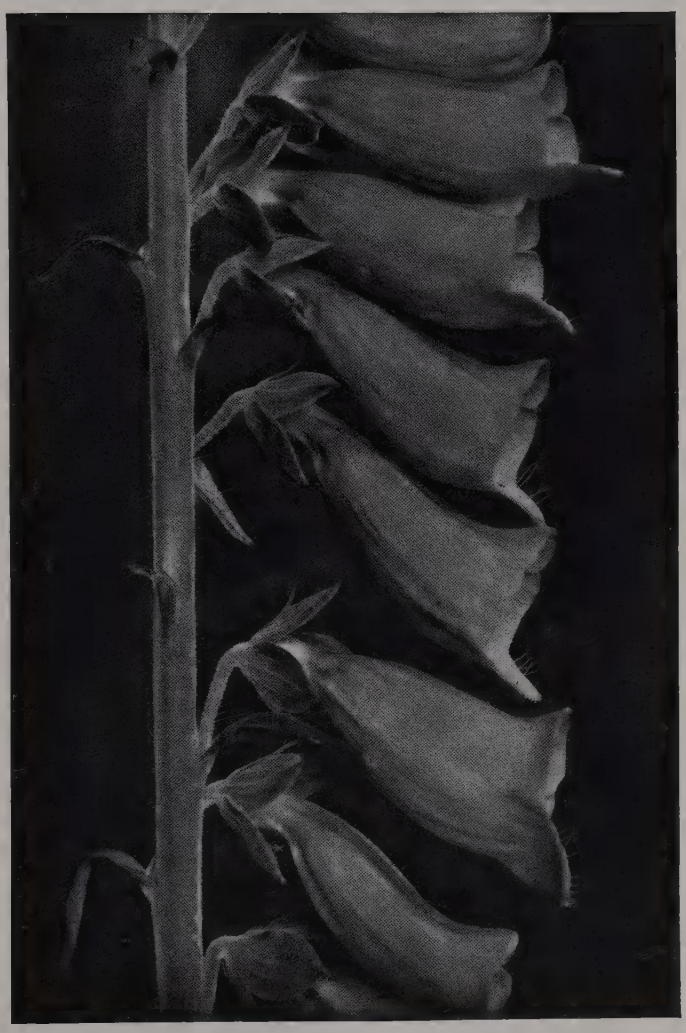


NETTLE STINGS (MAGNIFIED).

A very interesting problem which arises in connection with certain species of plants which seem to be specially protected is that of mimicry. The subject is one concerning which we have little positive knowledge, yet some of the instances are so striking that they cannot well be ignored. On the face of it there is, of course, nothing preposterous in the conception of plant mimicry, when we have so well established a theory on the same lines in the case of animals. The common Mint of our brooks, a particularly attractive plant, which sends up lusty shoots in the

early summer, is but rarely attacked, doubtless because of its strongly aromatic flavour. Now just at this time the Brooklime, another moisture-loving plant, starts to grow. These two plants, both found plentifully in damp spots, frequently intermingle; and at a little distance it is not an easy matter to distinguish the one from the other, so strong is the resemblance. It does not seem unreasonable to suppose that the Brooklime benefits to some extent by its resemblance to the Mint. Grazing animals cropping the herbage along the banks of the brook, would be likely to leave a plant severely alone which looked so like the aromatic Mint. Lord Avebury has pointed out the close similarity existing between the Scentless Mayweed and the Chamomile, both as regards leaves, flowers, and general habit. The latter species has a strong bitter taste which is likely to serve as a protection, and in its resemblance the Mayweed may possibly reap advantage. Of course, these last two plants are so closely related to one another that one should not perhaps attach too much importance to the likeness.

Far more remarkable than the instances of possible mimicry already mentioned are the large number of plants bearing a more or less striking resemblance to the Stinging Nettle, which, we must remember, is one of the best protected species in this country. This simulation is seen to its greatest advantage in the case of the so-called White Dead-Nettle (*Lamium*), a plant which is not even remotely allied to the Stinging Nettle. Especially is the likeness to be observed in the early stages of growth, before the white blossoms of the *Lamium* have been developed. Indeed, it is only after a critical examination that it is possible to tell the difference between the two plants, when, as is often the case, they are growing closely together. It is surely not an unreasonable supposition to suggest that browsing animals, and possibly even insect larvæ, may be deceived, and may pass over the harmless plant under the impression that it is the baneful one. At any rate, after a few experiences with the Stinging Nettle, one can hardly imagine an observant creature



HAIRS ON FOXGLOVE'S LIP TO EXCLUDE UNWANTED VISITORS.

venturing to meddle with anything that at all looked like the obnoxious weed. As has been suggested, there are quite a number of plants which bear a fair similarity to the true Nettle, such as the Red and the Yellow Nettle, the Betony, the Gipsywort. One can scarcely think that it is entirely chance which has ordered this remarkable repetition of one suggestive form.

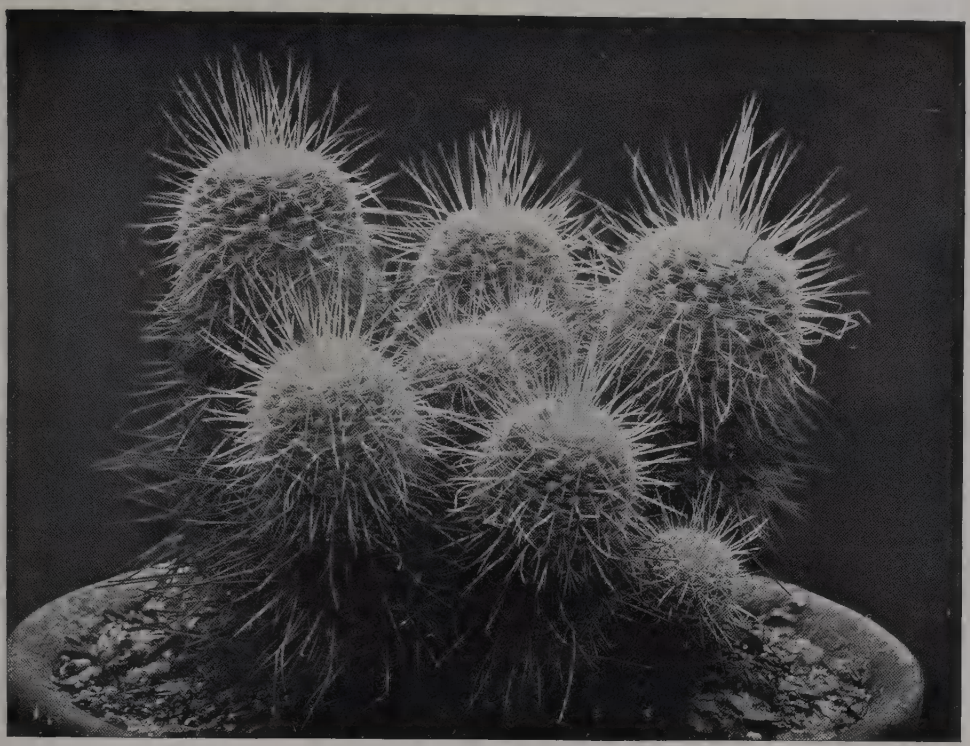
Whether anything which may be called protective resemblance exists among plants is at present an open question, but certain succulent species are very curious in this connection. The most striking of these plants is *Mesembryanthemum truncatum*, a South African species which flourishes in desert regions. The whole of this quaint vegetable consists of succulent shoots which grow close to the ground, and these so strongly resemble the stones among which they nestle as to be most perfectly hidden. Even after a close examination it is impossible to distinguish the plant from the stones. Several allied species are also remarkable on account of their rock-like appearance, which, whether it be accidental or not, can hardly fail to cause the plants to be overlooked time and again. A few of the Cacti may also be said to bear a strange resemblance to their environment, most striking of all in this direction being the *Cereus monstruosus*. This plant, which produces oddly-shaped stems, is coloured in such a dull brown manner that it does not look in the least like a growing vegetable.

It is often in the very beginning of a plant's existence that the most need arises for protective means. It is therefore not surprising to find quite a number of seeds which may be regarded as examples of simulation. Doubtless many of these resemblances are purely accidental, but in others one cannot but think that there is a real purpose in the resemblance. Many seed vessels bear an astonishing likeness to beetles and other insects. In a leguminous plant which is called *Scorpiurus* the pods so closely resemble a scorpion that even an experienced eye is deceived at a distance. In the same way the seeds of the Castor Oil Plant (*Ricinus*) are very much like a small beetle, and the resemblance is still more strong in the seeds of some of the species of *Jatropha*. More remarkable than any of the instances mentioned above are the large seeds of the genus *Chelonospermum*, plants indigenous to certain of the Pacific Islands. These most wonderfully resemble the giant Coleoptera, which are such a feature of insect life in this part of the world.

One can well understand that granivorous birds, which would tear these seeds in pieces and destroy them, might mistake them for very formidable beetles, and thus leave them alone. In much the same way the smaller seeds might be left alone by grain-eating birds, under the impression that they were insects. In passing, it may be pointed out that in the case of these latter it might be an advantage for them to be swallowed by birds, provided that their external coating was able to withstand the action of the digestive juices. Thus the resemblance which they bear to small insects would make them attractive to insectivorous birds, and even if the winged creatures did not actually swallow the seeds, they would probably be sufficiently interested to carry them a little distance before the mistake was found out.

The good things with which the flower is stored are not intended for all comers. The matter is viewed in rather a different light, however, by certain insects who seem to regard the feast as having been specially prepared for their delectation. To ward off the attacks of these plunderers has called for no little ingenuity on the part of the plant. There is little doubt that the shapes of certain flowers have been modified largely for the purpose of excluding small creeping insects. The urn-shaped blossoms of the Whortleberry secrete their honey right at the base of the corolla, where it can only be reached by long-tongued insects. Even if a creeping visitor could negotiate the rounded sides, it would not be able to enter the flower, so narrow is the opening. Many plants bearing flowers in which the nectaries and pollen are fairly accessible, arrange to prevent creeping insects from getting near to the blossoms at all.

The stems of not a few plants are densely covered with minute hairs, which render it almost impossible for crawling insects to mount up to the flower. In



A WELL-PROTECTED CACTUS.

some instances the hairs all point downwards, and this is to be observed in the case of certain grasses ; if the thumb and finger are moved up the stem a very perceptible roughness may be felt, which is absent when the stem is passed in an opposite direction. In other cases it is not until the visitor actually arrives at the flower that he is confronted with the barrier of hairs. In the case of the common Cornflower the stems and leaves are quite destitute of prickles, but the involucres forming the flower head are bordered with formidable teeth. The lip of the Foxglove is covered with long bristles which guard the entrance to the flower. These do not seem to trouble the humble-bees, which appear to be the only legitimate visitors to the flower. In the case of quite a number of plants, even the filaments of the stamens are clothed with hairs that form barriers in the way of tiny insects which would mount to the pollen-laden anthers. This is seen to a certain extent in the case of the Crocus, and to a much greater degree in the flower of the Bog Asphodel, where the stalks of the stamens are quite "furry" in appearance.

In a certain number of instances the presence of glandular hairs secreting a glutinous substance makes it difficult for creeping insects to get anywhere near to the centre of the flower. This is to be observed in the blossoms of the Gooseberry, and of the *Linnæa*. The calyces of the Plumbago and Honeysuckle are so thickly adorned with glandular hairs that small insects not infrequently get stuck fast when trying to approach the flower. This is seen to a much greater extent in the case of the *Silene nutans*, well named the Catchfly. Here the upper part of the stem, as well as the calyx, is viscid, and large numbers of small insects are to be found dead and dying upon the glutinous surface. Just at the time when the Rhododendron flowers are at their best the stem is peculiarly sticky by reason of a mucilaginous substance which is exuded. On this it is possible to find almost any number of little creatures which are captured whilst endeavouring to reach the blossom.

S. LEONARD BASTIN.

FISHES OF OUR SEAS

Their Shape, Size and Colour

By F. G. AFLALO

I—PLAICE, DORY AND GARFISH

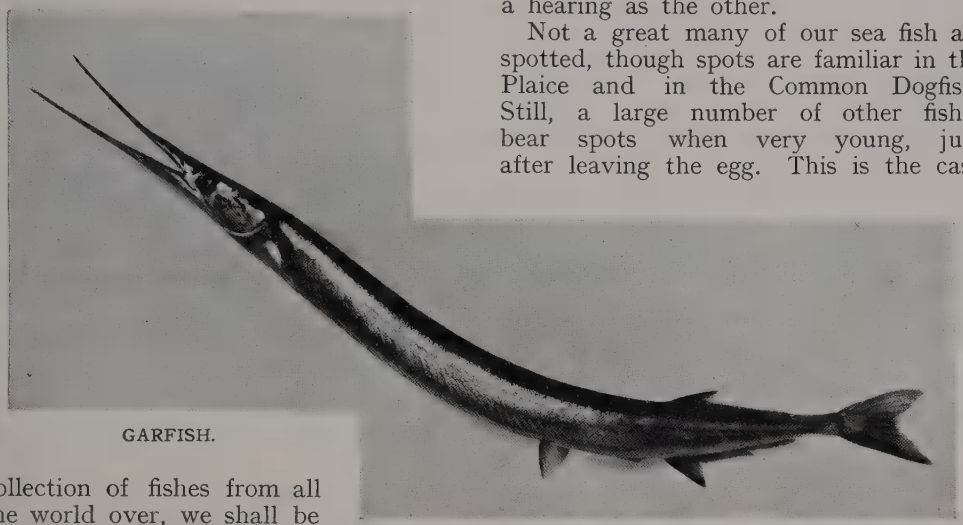
FROM remote ages the sea has been peopled with fishes, some of which at a later period found their way first into rivers and thence into lakes. The sea, however, the home of all life, was the cradle of the race, and although most of the salt-water fishes which we know to-day have been developed from forms long since vanished in the mists of antiquity, a few, like the Port Jackson Shark, retain the general characteristics of very ancient types encountered only in the fossil strata, and more familiar to the hammer of the geologist than to the nets of the fisherman.

Even the fishmonger's shop, in which not one in a thousand of the known kinds of sea fish is ever seen, will reveal at a glance the curious differences in shape, size and colour. True, the largest and the smallest fishes in our seas—the basking Shark, which grows as long as forty feet, and the little Sucker, which never exceeds four inches—are never seen in the fish market. Yet there is a wide difference in size between the great Cod or Halibut and the tiny Whitebait (really young Sprats and Herrings) with which we often see it garnished. In the familiar Mackerel, Plaice, Dory and Garfish, too, we have four widely divergent types of living fishes, of which the first-named may be regarded as the most usual form of fish —the typical, torpedo-shaped, silvery, forked-tailed animal with scales and fins and gills. All fishes have scales and gills,

PLAICE.

though in a few, like the Australian "Lung-fish" and some of its relatives in Africa and South America, we also find an arrangement for breathing air direct instead of, as is done by the rest, using such air as is suspended in the water.

What a range of colour, too, we find even on the fishmonger's slab: the blue and silver Mackerel, the brown, red-spotted Plaice, the duller Cod and Whiting, the scarlet Gurnard, and many others. If, instead of confining our survey to the fishmonger's, we pay a visit to the museum in Cromwell Road, where Mr. Boulenger has got together a wonderful collection of fishes from all the world over, we shall be amazed by the extraordinary variety of colour, for some of the Wrasses, Dragonets, Gurnards and Mackerels, the Opah, and others too numerous to mention, are a perfect blaze of colour. It would appear at first glance as if such skins, which seem to be modelled on the gaudiest Turkey carpets, would make their owners too conspicuous to their enemies, as well as to the smaller fishes, which many of them have to catch for their living; but a little inquiry shows that many of the most brilliant inhabit tropical seas, where the fierce sunlight makes them, in fact, harder to see than they would be in duller coats.



GARFISH.

As in birds, too, the male is sometimes more gaily dressed than the female. The gemmeous Dragonet is a well-known case of this difference between the sexes, and the female, a homely little thing beside her resplendent mate, was long thought to be a distinct kind of fish, and was always referred to as the Dusky Skulpin. There always has been a good deal of discussion among naturalists as to the meaning of these differences. Some are of opinion that the males display the brighter colours to be attractive to the females. Others hold that the females gladly wear quiet colours in order not to be seen during the time they are laying their eggs, a provision of Nature for the maintenance of the race. These are mere guesses, and both may be wrong. In any case, one opinion is as much entitled to a hearing as the other.

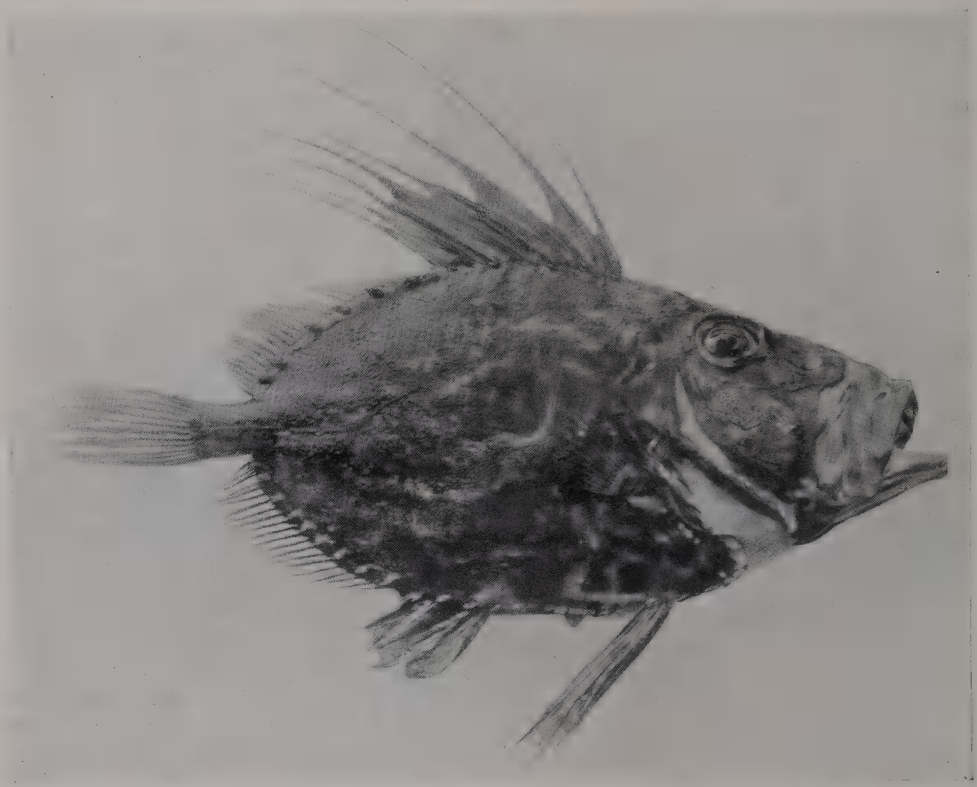
Not a great many of our sea fish are spotted, though spots are familiar in the Plaice and in the Common Dogfish. Still, a large number of other fishes bear spots when very young, just after leaving the egg. This is the case with young Cod, which may be compared in this respect with lion cubs, which are generally spotted at birth, though they lose their spots in course of time. Other fishes, like the Dory and Turbot, have a chameleon-like trick of changing their colour to suit their background, and the Wrasses, brilliantly coloured fishes that are of no use for the table, also possess this peculiarity.

Reverting for a moment to the shape of our British fishes, there are many remarkable types which are never seen at the fishmonger's, save occasionally as exhibits to attract buyers. There is the Sunfish, an extraordinary globular monster, which may weigh over 500 lb. There is the Swordfish, which is armed with a long bone on the snout capable of

inflicting severe damage on nets. I lately saw a number cruising around the Sea of Marmora and neighbouring waters, their great sail-like fin showing above the surface for miles. Several were taken in the local "Talian" nets during my stay in the Gulf of Ismidt, so that I had many opportunities of handling them. Then there is the Sturgeon, a bearded dweller in Russian rivers, which occasionally wanders as far as the coasts of Britain. The great Tunnies and Bonitoes, which look like magnified Mackerel, are also among our rare visitors.

The curious Angler-fish is a native, taken only as a rule in the trawl, though now and again on the hook. It has a little fishing rod on the top of its head, and with this it angles in the dark caverns under the sea, attracting little fishes with the silvery bait and then swallowing them in its enormous mouth. It preys not only on fish, but also on diving birds, and both Cormorants and Razorbills have been found in its stomach. A Cormorant, swallowed whole, should be a dish for an epicure!

Now and again the fishermen tell one of curiously shaped fishes in a particular district. As a case in point, mention may be made of the short-nosed Sea-bream familiar round Plymouth, which look as if they have lost the upper jaw. As a matter of fact, they have, and the explanation lies in the fact that when they are very young, and known as "Chad," they so worry the hooks with which the fishermen are trying to catch something bigger that the men continually jerk the lines, thus tearing away the upper jaw of any fish too small to get itself properly hooked. The fish thrives in spite of this deprivation, and in time quite a number of large deformed Bream find their way to the Barbican, which is the Plymouth fish market.



From a photograph by Edward Step, F.L.S.

JOHN DORY.

Not only do different fishes vary very much in size, but the same fish shows differences in waters far apart. When I say "the same fish," it is perhaps more correct to regard these as different "races," which means that, while they are not sufficiently unlike to make them two separate "species," the difference in size constitutes a distinct race. When, many years ago, I lived on the shores of the Baltic, I noticed that the Herrings were much smaller than those of our east coast, but I did not then know that they never grow any larger. In like manner, the Mackerel of the Mediterranean are also much smaller than our own. Here, again, it is a matter of race, for in the teeming waters round Constantinople there are millions of tiny Mackerel, known as "*Ciri*," which the native fishermen catch in tons; and there are also enormous Mackerel, which, every few years, bank in such enormous masses that it is computed that no fewer than a million are taken every night for a month. The Plaice is another fish which shows a wide range in size, and the Baltic also has a small kind of Plaice which never grows any bigger. Possibly, the small size is a question of a shortage of food.

F. G. AFLALO.

THE GREATER WHITETHROAT AND YELLOW-HAMMER

By BENJAMIN HANLEY

With Photographs by the Author

THE Whitethroat, an excitable little brown bird, is one of the commonest of our warblers, and is to be found by almost every wayside during the summer months, for, like other warblers, it is a migrant, spending the winter months in Southern Africa, arriving here toward the middle or end of April and leaving early in September.

It is an interesting little bird, and not the least noticeable trait is its habit of dancing or fluttering along the top of a hedge or bush with head feathers raised in the form of a crest and throat puffed out, often flying into the air a little way to sing a pretty but short song, and then, as suddenly, dropping again.

For nesting sites, a nettle bed, wild

NEST AND YOUNG OF WHITETHROAT.

NEST OF YELLOW-HAMMER.

rose or bramble bush, and tangled vegetation by the hedgeside may be chosen.

The nest is a very frail structure made of hay and fine dead stems, lined with horsehair. The eggs, five or six, are greenish white with close ash-grey mottling—sometimes thicker at the larger end.

This bird is an insect feeder, but it also partakes of a little fruit if such can be had. It has a rather harsh alarm note, and a scolding one, which often leads to its being mistaken for the Sedge Warbler. Two well-known local names are "Peggy Whitethroat," or even "Peggy," and "Nettle-creeper," the latter from the bird's habit of frequenting nettle beds.

One of the most conspicuous of our wayside birds is the Yellow-Hammer, with his bright yellow head and breast; and although no songster of high degree, he is a great favourite with many, and I think all will agree that the countryside would feel the loss of his song, which may be heard constantly during the hot summer days when other birds are mostly silent. It is a rather plaintive song, inclined to be monotonous, often likened to the words "A little bit of bread and no cheese," the "no" being emphasized and the "cheese" long drawn out.

Only the male has the bright yellow colouring; the female is streaky brown with just a trace of yellow on head and breast. It is usually a late nesting bird. I have often found the nest in August, and I once saw one with eggs built in the side of a newly made barley stack in September. The nest is usually placed on the ground, or near it—a hedge bank being a favourite situation.

YELLOW-HAMMER (FEMALE).

SUNLIT MEADOWS.

From the Oil Painting by Algernon Talmage, R.B.A.

YOUNG BLACK-HEADED GULL SWIMMING.
About five weeks old.

THE BLACK-HEADED GULL

"All day long their nesting haunt is a scene of animated life"

By BENJAMIN HANLEY

With Photographs by the Author

ACRES and acres of heather, stretching as far as eye can follow, broken here and there with great whin bushes ablaze with gold, silver birch, mountain ash, or dark spruce fir. Along the horizon stretch dark pine woods beloved of the wood pigeon, and just in front long, narrow streaks of silver tell of marsh and fen or boggy pool, the haunt of the waterfowl—wild duck, coot, moorhen, or little grebe—and here, too, nests the Black-headed Gull (*Larus ridibundus*).

As one approaches, a vast flock of Gulls, thousands in number, arise from their nests amid the reeds and sedges fringing the pools. Higher and higher they rise, presently to wheel and turn in all directions, all the while creating a clamour well-nigh deafening. The Gulls arrive at these inland nesting haunts in considerable numbers about the third week in March, and the eggs may be found about the second week in April and until the end of June.

The nest, built up of aquatic grasses, is placed amongst the reeds fringing the pools. In some cases scarcely a handful of material is used, on odd occasions

nothing at all; and at others it is quite an elaborate structure, dead sticks and twigs, sprays of heather and furze being utilised as well as grasses. Much depends upon the situation chosen. If the reeds are thick, little nest is required to keep the eggs clear of the water; but in others a quantity may be necessary. I have found the nests placed on the ground at some distance from the water. The birds nest in close proximity, the small reedy islets dotted about the ponds being the most used. On one such islet only about eight feet in length and four feet in width, I saw no fewer than twenty-one nests this season. The eggs, two to three in number, are subject to great variation not only in regard to colour, but also size and shape. Some are pear-shaped, like the plover's; others rounded like a pigeon's. The average size is two inches by one and five-eighths. The ground colour may be anything from pale bluish green to amber brown, spotted and blotched with dark grey and blackish brown. In some cases the markings form a distinct ring round the larger end, and in others are quite evenly distributed. On odd occasions pale blue eggs without any markings may be found, and I have seen a clutch the same ground colour covered with fine light brown spots. One of the three eggs is generally different from the remaining two.

Sometimes four eggs may be discovered in a nest, but this is not at all usual, and generally is the result of two birds laying in the nest. However, they have been found where the close similarity of the four eggs left no doubt that they were the product of one bird.

The young are clothed in a down of yellowish buff and brown, and take to the water when quite young. Their first feathers begin to appear when about three weeks old, but the youngsters are unable to fly until about a month later. When fledged their plumage contains a good deal of brown, but not so much as in the case of the young of other Gulls. It is interesting to note that the Gulls endeavour to knock their young into the water during their first attempts at flight, doubtless because of their thinking the young birds are at such times scarcely strong enough to undertake aerial navigation successfully.

With strangers the birds are very shy,

YOUNG BLACK-HEADED GULLS.

BLACK-HEADED GULLS AT NESTS.

BLACK-HEADED GULL ABOUT SIX WEEKS OLD.

NESTS OF BLACK-HEADED GULLS.

and rise off the nest when one is a hundred yards away, but in time they become fairly tame. This season I spent a week amongst them, and after the first two days I was able to approach within twelve feet of the sitting birds without alarming them, and if they were disturbed from any cause they returned to their duties without hesitation. Often two birds would claim the same nest; this resulted in a short, sharp fight, the loser flying aimlessly up and down just as if it were quite unable to find its own nest; indeed, such apparently was the case on the face of things.

Throughout the country there are many well known gulleries, the largest being at Scoulton Mere, where the birds have nested in thousands for upwards of three hundred years. Some, however, are of comparatively recent formation, this being so in the case of that where the accompanying illustrations were secured. In 1899 only six pairs nested in this locality, the following year twelve pairs, and again in 1901 only six pairs, but since that date they have been rigorously protected, and the rate at which they have increased is hardly credible, this season the number of nests being considerably over one thousand. Although gregarious as a rule, solitary pairs are not infrequently met with amongst the hills and tarns.

From the beginning of July the birds commence to leave their nesting haunts for the coast, and by the end of the month the breeding grounds present a deserted appearance save for the presence of less noisy waterfowl.

The name of "Black-headed" Gull is scarcely appropriate, inasmuch as it would lead one unacquainted with the bird to get a wrong impression of the colour of its head, which is not black, but during the breeding season dark chocolate brown, with a distinct white ring round the eyes. The rest of the year the head is nearly white, for as summer advances the white ring round the eyes gradually extends until it spreads completely over the head with the exception of a small patch over the ears.

In the case of some birds, however, this brown colouring appears to remain throughout the year; and, on the other hand, cases have been known where the bird, having put off this dark hood, has

FINDING A BLACK-HEADED GULL'S NEST.

never regained it. These cases would tend to strengthen the theory that the bird does not moult at these times, somehow the feathers merely undergoing a change of colour.

The bill and legs in the adult are bright red, and these, with the brown hood, contrast strangely with the snowy white and pearly grey plumage. It is when following the plough they are seen to advantage, the freshly turned-up brown soil forming an ideal background for showing up the delicate shades of grey.

The agriculturist is beginning to recognise in this bird a useful ally, whereas formerly, under the name of "seacrow," they were shot when opportunity offered, for it almost rivals the rook in devouring innumerable wireworms and other noxious grubs. Sad to say, this is not universally recognised, as is proved by the fact that during the nesting season numbers are picked up dead on the nest or in the water near by, having been shot whilst away and reached home only to die.

Although protected whilst at their nesting haunts from the attacks of man, they are not immune from the ravages of other foes. Numbers of eggs are sucked and young killed and partly eaten by brown rats—not water-voles—which, contrary to what one would think, enter the water and swim to the nests for that purpose.

When in flight the Black-headed Gull may be recognised, apart from its smaller size, by the conspicuous white edge along the front of the wings.

The usual note of this Gull is a harsh "Kak, kak," but when excited or alarmed this becomes a loud scream. All day long their nesting haunt is a scene of animated life, and the noise created is indescribable. As nightfall draws on the birds which have been away foraging in the fields one by one return to the gullery, each fresh arrival being greeted with renewed clamour. At length, as dusk falls, and even the very last stragglers are safely home, they settle down for the night; then, in contrast to the discordant screaming of the day, a stillness, almost eerie in its intensity, reigns unbroken, save for the peewit's plaintive cry or moorhen's croak. And so they rest until the eastern sky gives promise of another day's awakening.

YOUNG BLACK-HEADED GULLS IN NEST.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—III

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE DOGWOOD THE PRIVET THE BOX

THE DOGWOOD

SPITE of the name, and notwithstanding its associated traditions, this shrub has nothing to do with the dog. Its original designation seems to have been Dagwood, the wood out of which "dags"—any loose ends of wood for special purpose—were made. A similar name, formerly current, was Gadrise, meaning the shrub from which "gads" or goads were taken. It is easy to understand that in the simpler times, when the countryman's instruments were for the most part home-made, being cut as required from the living wood, this shrub, as others, was named rather from the use to which it could be put than from any distinctive peculiarity of growth. Hence it is that these familiar names are of small service in the matter of identification.

DOGWOOD FLOWERS.

The most distinctive characteristic of this shrub is the brilliant blood-red colouring of its twigs, particularly in late winter and early spring. Again, in autumn, colour becomes a distinguishing feature. No British tree or shrub can compare, for exuberance and richness of varied hue, with the crimson, orange, rosy red and purple, separate or combined, of the Dogwood's fading foliage. Abundant in the south of England, and particularly in the chalk districts of the south-east, it is of much rarer occurrence elsewhere.

The straightly ascending main stems give it a somewhat erect habit of growth. The buds are slender and are pressed up against the twigs, being arranged in opposite pairs. They are protected by scales and are velvety to the touch, as also are the twigs. The leaves are a broad oval terminating in a point. The

DOGWOOD FRUIT.

margins are without teeth. The venation, similar to that of the Common Buckthorn, shows three pairs of strong secondary ribs branching from the lower half only of the midrib, and sweeping in graceful parallel curves towards the terminal point.

The flowers are gathered into dense stalked clusters at the ends of the shoots. The creamy-white colour and rounded shape of these flower clusters should distinguish them at once from those of the Privet, with which they are liable to be confounded, especially when seen in the hedgerow. Each flower is complete, having four narrow, creamy petals, four yellow-headed stamens, and a pistil. Nectar is exposed and attracts numerous insects, mostly flies. The fruit is globular, bluish-black in colour, bunched at the end of a single branching stalk. Each is a stone fruit with double seed chamber.

THE PRIVET

This, as a wild plant, has practically the same range as the Dogwood, being found chiefly in the chalk and limestone districts of the south. Its partially evergreen character, its multiple branching, and its adaptability under the shears, rendering it pre-eminently suitable for the garden hedge, have occasioned its almost universal planting for that purpose.

The minute buds are protected by about four flattened scales of a purplish-green colour. The leaves, in opposite pairs, are oblong, tapering to a point at either end. The stalks are short. The texture of the blade is smooth and firm, but it lacks the hard leatheriness so characteristic of the true evergreen. A few weak and sinuous secondaries branch off from the main rib, but these are scarcely discernible. Except in very severe winters the leaves, which may become a deep bronze in colour, remain attached till the new buds commence their growth in spring.

DOGWOOD LEAVES.

The flowers, gathered into pyramidal clusters at the ends of the shoots, are a clear white. Each has four petals forming a short tube with turned-back lips, very like the flower of the lilac, but smaller. Each is complete with stamens and pistil. Bees, butterflies,

FRUIT CAPSULES OF BOX.

flies, and beetles are assiduous visitors. The fruit is globular — a shining black " berry " enclosing in its purple pulp a single two-celled stone. If bullfinches are anywhere in the neighbourhood they will be sure to visit a Privet hedge some time in the course of the winter, searching for the fruit.

THE BOX

Really a shrub, the Box makes some small pretence to being a tree, though not with any conspicuous success, as in the woodland undergrowth on Box Hill in Surrey. Their lanky stems, generally several in a group, straggling into and among the overgrowing Yew or Beech, give the impression of " legginess," as a gardener would describe it, rather than of a sustained standard growth. Many of these reaching a height of fifteen or twenty feet, with a greatest diameter of about six inches, densely branched and foliaged, but with little of defined shape in the crown, serve mainly to deepen the shade in which they live and seem to thrive. Out in the open, with light reaching them on every side, they form by preference dense rounded clumps, stems and branches completely hidden by the close-set evergreen foliage.

The bark is yellowish and smooth with a tendency to scaliness. The buds are scarcely discernible. The twigs are four-angled. The leaves, under an inch in length, are oval, not pointed but frequently notched at the apex. They are polished above, of a deep full green, matt beneath and paler. In texture they are hard and leathery. The secondaries, branching from the midrib, are straight and parallel, but obscure. The series of

FRUIT OF PRIVET.

LEAVES OF BOX.

small shrubby plants—whortleberry, cranberry, etc.—have very similar leaves, but with these plants the leaf arrangement is alternate, whilst that of the Box is opposite.

The flowers cluster at the base of the leaves and seem to encircle the twig. They are of two kinds, though found in a single cluster. Centrally is a three-angled pillar-like body having three projecting parts at the top. This is the fruiting flower and matures first. A little later this is beset at its base by what seems a crowd of yellow stamens. A closer scrutiny will show that these are grouped in fours, each set rising out of a tiny saucer-like receptacle, which with the stamens constitute the pollen-bearing flower. There are no petals. These flowers are visited by bees for the sake of the pollen, but this probably has little effect in the matter of fertilisation, which is almost, if not entirely, dependent upon the wind. Lord Avebury states that since the pollen, "like that of wind flowers generally, is dry and dusty, the hive bee moistens it with nectar from its mouth and then brushes it on to its hind legs."

The fruit is an erect three-celled capsule with three projecting points at the top. Each cell contains two black seeds. When ripe the cell splits open lengthways, exposing the pair of seeds partially enclosed in an inner chaffy chamber. The walls of this inner chamber contracting, pinch the seeds till, slipping free, they are ejected to a considerable distance. These seeds germinate freely, and multitudes of seedlings spring up in the vacant spaces, maintaining a woodland undergrowth in those spots, as on the summit and slope of the chalk down, where the Box thrives in association with the Beech and the Yew.

HENRY IRVING.

FLOWERS OF BOX.

SENSITIVE PLANT AFTER CONTACT.

CHAPTERS IN PLANT LIFE

VII—THE FEELINGS OF PLANTS

By S. LEONARD BASTIN

With Photographs by the Author

QUITE a short while ago the vegetable world was considered to be something very distinct from the animal kingdom. The difference between the two living creations appeared to be so sharply defined that the idea of any connection seemed to be entirely out of the question; at any rate, such was the view of the matter to those who were content to take a mere external survey. It is now, of course, well known that in the primal forms of existence plant and animal so closely resemble one another that the keenest investigation fails to establish any line of demarcation. Indeed, the same basis is responsible for the manifestation of life equally in the vegetable and the animal. In the green chlorophyllian tissue of the plant can be recognised the wonderful protoplasm, no less than in the specialised nervous system of the animal. This being so, it is a matter of great interest to consider the response of the living matter in the vegetable to external stimuli, and thus find further evidence of the

intimate relations between all living things.

In the old days it was often suggested that plants cannot feel, although on what grounds the assertion was made it is not easy to see. Reduced to its simplest possible form, the ability to feel merely indicates the power of response to a stimulus. The pupil of the human eye is so delicately adjusted that it can feel the influence of light, contracting when an increase in the amount of illumination takes place, and expanding when the light-rays are few in number. It is easy to prove that a plant can feel the light. Place a healthy specimen in front of a window in such a position that the light can only reach it from one direction. In a few days the growth of the plant is entirely altered; its upright bearing goes, and it leans over so that the upper surface of its foliage may be fully exposed to the stimulating rays. The same point may be very strikingly illustrated if a small collection of seedlings is grown in a box with a single aperture, when it is seen that all the young stems turn towards the path of the light. Some little plants are astonishingly sensitive even to very feeble illumination.

Darwin showed that the cotyledons of Phalaris became "curved towards a distant lamp which emitted so little light that a pencil held vertically close to the plants did not cast any shadow which the eye could perceive on a white card." In another experiment it was shown that if seedlings kept in a dark place were laterally illuminated by a taper for a minute or two at intervals of three-quarters of an hour, the little stems leaned over to the direction from which the intermittent light had come. Normally the extreme sensitiveness of leaves to the action of light is well seen in the case of climbing plants, particularly when the specimens are growing up a wall. Even though the effort may entail considerable distortion of stalk, the leaves are invariably brought round so that the face

THE SENSITIVE PLANT.

THE TENDRILS OF THE VIRGINIAN CREEPER TURN AWAY FROM THE LIGHT.

of them is held outwards. It is easy to understand that it is to the advantage of most plants to bring their foliage into such a position that a maximum amount of light is secured. Movement towards the light is not an invariable feature in the organs above ground of all plants. In the case of the Ivy there is a distinct tendency for the shoots to bend away from the light.

More strange still is the behaviour of the tendrils of the Vine and Virginian Creeper. These processes always shun the brightly illuminated quarters, and seek out the dark parts. The phenomenon is all the more remarkable when it is remembered that in origin these tendrils are modified leaf-shoots—portions of the plant which in the ordinary way would certainly not turn away from the light. That the tendrils are more likely to obtain a hold by directing their growth to the dark cracks and crevices than if they grew out to the light, is, of course, obvious. A most curious instance in which the same part of a plant is affected by light in different ways at different times is to be seen in the case of the Ivy-leaved Toad-flax (*Linaria cymbalaria*). The flower-stalks at first incline towards the light, but as soon as the blossoms have been fertilised the stems turn in an opposite direction and so bring the capsules into a position for planting the seeds in the crevices.

On occasions the foliage of the plant is seen to shun the light. It is noticed by all travellers that the Australian forests offer very little shade; this is simply due to the fact that certain of the trees (particularly the Eucalypti) hold their leaves edgeways to escape the fierce rays of the sun. It is curious that the seedling Eucalyptus trees bear their leaves laterally. Of course, these young specimens growing in the partial shade afforded by their parents are not likely to suffer harm from the sun's rays. The so-called Compass Plant (*Silphium*) has leaves which twist laterally when the sun shines upon them, and in this way avoid the injurious effects of too strong an illumination. Many plants under the influence of very strong sunlight droop their foliage; partly, of course, because of the excessive transpiration of moisture; but we may take it that the change in position is a useful protective measure.

As to the causes which underlie these light-seeking and light-avoiding movements, we cannot find any all-sufficing explanations. Certain it is that they only continue so long as the plant is in a growing state. We know that light has

a retarding influence on growth, and it has been suggested that plants lean towards the point of illumination, because the shady side of the stem extends more rapidly than the part which is strongly lighted. This theory does not help us to understand how it is that parts of the plant avoid the light. One cannot but feel that in all these phenomena there is something more than a mere mechanical adjustment, and that most of these responses must be the outcome of inherent tendencies which exist in the plant. Whilst a little observation destroys the illusion that the Sunflower always follows the sun, there is no doubt that the plant, in common with a large number of species, does move its blossoms towards the glowing orb. This is perhaps particularly noticeable in the case of composite plants.

VENUS FLY-TRAP, OPEN.

The Common Hawkweed, which grows so abundantly in our fields, leans its blossoms over very distinctly to the sun. Thus an observer standing with his back to the south sees the field as a blaze of gold, but turning in an opposite direction there is nothing to be noticed save the backs of the flowers. Much the same kind of thing is to be seen in many species of Anemone. On a brilliant day it is observed that the copse appears to be starred all over with the white flowers of the Wood Anemone, but with a slight change of position the flowers seem to disappear, simply because the blossoms are all fronting in one direction.

The Sensitive Plant is a species with many interesting points. This curiosity goes to sleep every night, but, of course, the most striking feature of the plant is its extreme sensitiveness to contact. As is so well known, the lightest touch is sufficient to make the leaflets close upon their support, the petiolules to draw up together, and the leaf-stalks to collapse. The most singular feature is that the shock may be communicated to other parts of the plant, and even, at times, to the whole specimen. The Sensitive Plant has something which is strangely like a rudimentary nervous system, in that it would seem that there is a continuity of susceptible matter throughout the whole specimen. There is little doubt that the contractile power resides in small cylindrical cushions—pulvini—which occur at the points of insertion of the leaf-stalk with the stem.

A pulvinus is a process containing a woody centre surrounded by spongy cells rich in water. Now, when one of the leaflets of the Sensitive Plant is touched, the effect is transmitted, probably by the threads of protoplasm passing through the cell wall, to the pulvinus.

The outcome of the reception of the shock is that the water passes from the cells on the lower side of the process to those in the upper part, and, as a consequence, the former portion becomes

flabby and is no longer able to support the leaf-stalk. Thus the organ falls by its own weight. After an interval the water in the cells regains its original distribution and the leaf assumes its normal position.

It is only during the period of active growth that the Sensitive Plant exhibits great susceptibility. Moreover, a high temperature seems to be an essential feature of a prompt response to touch on the part of the specimen. Up to a certain point the Sensitive Plant seems to be able to become accustomed to shock. A curious experiment was conducted many years ago in which a young specimen of the plant was placed in a carriage. Directly the vehicle started to move the plant drooped its leaves, but as the movement continued, the effects of the shock became less and less until something like a normal position was assumed.

Certain plants are curiously responsive to electrical influence. One of the most remarkable of these cases is that of the *Abrus precatorius*, an Indian leguminous plant. The behaviour of this species has given rise to a good deal of speculation from time to time, and it has been claimed that warnings of the approach of magnetic storms and electrical disturbances may be gathered by a close observation of the position of its leaflets. This is certainly crediting the plant with powers which it does not possess, although there is no doubt that the Abrus is responsive to the variations in illumination, temperature, etc. It is doubtful whether the plant is more sensitive in this way than the Mimosa. A young specimen, which the writer had in his possession, evinced considerable leaf agitation during the progress of a thunderstorm. Almost all these sensitive plants are very much affected when exposed to the vapours of an anæsthetic ; in this instance the foliage assumes the position which it takes up at night.

The Telegraph Plant (*Desmodium gyrans*), has well been called one of the most curious in the world. Certainly it presents a problem which has completely baffled all scientists. The leaves of this species are divided into three parts, consisting of a large leaflet and two smaller lateral ones. It is these latter which offer a strange phenomenon, and one which is not at all easy to explain. Practically throughout the whole of their existence these leaflets are in motion, executing little jerks, which suggest the movements of the seconds hand of a watch. When one of the leaflets rises the other descends, each in its turn describing a kind of elliptical course.

VENUS FLY-TRAP, SHUT.

These movements occur throughout the life of the plant, although the greatest activity is evidenced by the leaflets during humid days when they are under the influence of bright sunshine. The duration of each movement varies from about

one and a half to three minutes, and if a leaflet should be restrained for a while, the rate of travelling is very much increased. Although it is nothing like so perceptible, the larger leaflets also change their position, moving first to the right, and then to the left, with a slow, continuous movement. The most singular point about the jerks of the leaflets of the Telegraph Plant is that they seem to occur quite spontaneously, and not in reponse to any external stimulus. The explanation of this strange phenomenon is still wanting, neither is it easy to see that the plant derives any benefit from its remarkable habit. Specimens of the Telegraph Plant are to be seen in most botanical gardens.

Among the insectivorous plants there are to be found some striking instances of plant sensation; indeed, certain of the species are very highly specialised in this direction. The Droseras, or Sundews, are well-known little plants found in various parts of the world, the genus being represented in Great Britain by three examples. The Round-leaved Sundew (*D. rotundifolia*) is found commonly in boggy places. The plant, although small, is rendered somewhat conspicuous on account of its rosettes of bright-red leaves. It is worth while to examine the foliage rather closely. The leaves are seen to be covered with clubbed hairs, at the ends of which are produced sticky glands.

It is strange that the foliage of the Sundew seems to have a peculiar fascination for flies and other insects, albeit that these little creatures as a rule, pay a heavy penalty for their curiosity. So sensitive are the hairs on the Sundew leaf that the struggles of a fly held by the sticky secretion induce the processes to close round the unfortunate victim, so that escape is quite out of the question. At the same time these movements are accompanied by an excretion of a digestive fluid which aids the leaf to assimilate the nitrogenous matter in the body of the fly. Another curious feature in the behaviour of the tentacles of the Sundew leaf is that they entirely fail to respond in any way to drops of water which are allowed to fall on the foliage. As well, too, it is remarkable to note that although small stones may be enclosed by the tentacles, yet in these instances there is no discharge of the digestive fluid.

Even more remarkable than the Sundew is the Venus Fly-trap (*Dionæa muscipula*), a little plant which is a native of the swamps of North Carolina. The leaves of this plant, which mostly lie out flat on the soil, are composed of two very distinct parts, a stalk and a blade. The stalk, a leafy expansion which really performs the functions of ordinary foliage, is joined to the blade by a narrow neck. The blade is formed of two plates which are united by a rib fashioned somewhat on the lines of a hinge. The outer edges of the plates are furnished with borderings of rough bristle-like hairs. The sensitive part of this little trap exists in three cilia arranged in triangular fashion on each half of the blade. To touch one of these ever so lightly is to induce a rapid closing of the little apparatus; the plates snap up together, the fringe of hairs interlocks—the whole proceeding strongly suggesting the shutting of a very perfectly contrived trap.

Now, if the object which comes into contact with one of the sensitive hairs should happen to be a fly, the result is, of course, disastrous for the unfortunate insect; no escape is possible for the victim, whose body will be retained by the Dionæa leaf until the desired nutrient properties have been absorbed. In order to attract the flies, it appears that the upper surfaces of the plates are furnished with certain small glands which secrete a viscous fluid peculiarly alluring to insects. It is singular that no other part of the leaf of the Venus Fly-trap is at all responsive to contact. The back of the organ, even the surface of the plates themselves, may be touched; but unless one of the bristles is jarred the little trap remains immovably open. Experiment with this strange plant showed that whilst the blades would enclose small pieces of stone, for instance, yet these would not be retained for any length of time. A short while after acceptance, the blades will slowly open and permit the unwanted substance to roll away.

There is no doubt that there is a great deal in the behaviour of roots which it is

not at all easy to explain. Indeed, Darwin has gone so far as to say that the tip of the radicle, in its power of directing the movements of adjoining parts, acts like the brains of some of the lower animals. Much that the growing roots accomplish, however, is the outcome of simple circumstance. We are no longer puzzled, as were the old botanists, by the manner in which roots will seek the damp portions of the soil. The additions to growing roots will take place along the line of least resistance; this will naturally be through the soil which has been loosened by water. In this way the roots will ultimately arrive at the source of the moisture.

LITTLE FERN SENDING DOWN ROOT ON OUTSIDE OF POT TO WATER.

Other problems presented by roots are not nearly so simple, and lead one to the conclusion that these organs may be able to feel at a distance. The roots of trees will not infrequently force their way in between the brickwork of wells some distance above the water level, finally spreading out downwards until their growing points are completely immersed. A little fern, which the writer had in his possession, was most interesting in this connection. The plant was growing in a pot which always stood in a saucer of water. It would seem that the supply of water was not sufficient for the needs of the specimen. On this account the plant actually sent down a root on the *outside* of the pot to the water in the saucer beneath. It is sometimes noticed that the roots of tropical Aroids, such as the Monsteras, when grown under glass, are very clever in directing the growth of their roots towards water tanks which may be beneath them.

A very singular case of root perception, and one which it is interesting to recall, is recorded by Carpenter. He tells us that in a hollow in the upper part of an old oak, the seed of a Wild Service Tree was accidentally sown. After the germination of the seed the little plant grew for a while in the decayed vegetable mould collected in the opening. As the young tree increased in size, however, the need for more room made itself felt, and accordingly an attempt was made to reach the ground. The roots were sent down inside the stem of the tree, which was hollow. In the soil to which they directed their growth there was a large stone—about a foot square. If the direction of growth had remained unchanged, the roots would have simply come right down on to the stone. Strangely enough, about half a yard above the stone, the roots divided into two parts; thus when reaching the ground the soil was penetrated on either side of the obstruction. It is not at all an easy matter to offer an explanation of a phenomenon of this nature, which in slightly different form is not an infrequent occurrence in some of our older forests.

S. Leonard Bastin.

AN EXCEPTIONALLY STRONG SWARM WEIGHING 11 lbs.—55,000 BEES.

WOODLAND STORIES

THE QUEEN'S FLIGHT

By S. L. BENSUSAN

With Photographs by G. E. Green

CONSCIOUSNESS had hardly been hers in the five days that were passed. In the form of a grub such little recognition of outside influences as came her way was no more than the pleasant sense of wants supplied. She was in a cell depending solitary from the edge of the comb, larger than the ordinary cells and shaped roughly like an acorn. Into the mouth of this cell in those brief days of consciousness the nurse bees were busy emptying a rich store of bee milk made up of pollen and honey, that they themselves had digested before they gave it up to their nursling. There was more than the young grub could receive; it overflowed into the cell where she was spinning the silken shroud that was to wrap her for more than a fortnight's sleep. The nurse bees sealed down the mouth of her cell, but there was a generous allowance of space and air, and in those blind depths, which no human eye can picture, the Queen Bee grew and woke to a sense of anger and excitement that expressed itself in a shrill cry.

"Let me out," she shrilled, "I am a Queen Bee, and there are others in this hive. Let me go that I may do battle with them." All round her the guard was stationed, she remained a prisoner. But far above her, in a corner of the hive, came an answer to her challenge, the

cry of the Old Queen bee, her mother. "I have kept my sword for you and for all your sisters," cried the Mother Queen; "there shall be but one mother in this hive." Then there was a sound of scuffling and remonstrance, a shrill cry of rage repeated over and over again; while a sense of excitement and turmoil seemed to pass almost physically over the hive, communicating itself to the worker bees as they came in laden with pollen and nectar and to the drones as they lumbered clumsily home from the fields, careless of everything save abundance of sweets and long hours of rest. Then the outcry died away, the Old Queen had been appeased.

Of food the Young Queen found plenty, but her liberty was yet to come, for as soon as one of her guards went off duty another came to take his place; and, at times, the Old Queen could be heard making a fresh effort to break through the living wall round her and work a savage will upon her helpless children. From three other parts of the hive the challenge of the queens was answered. The workers had made four queen cells, taking eggs to them from the worker cells. In each a bee, equipped to become a mother of more than 250,000 children, was calling for liberty and battle. Towards noon on the following day, after long hours of extraordinary turmoil, followed by a few minutes of complete silence, there was a rush as of many thousands leaving the hive. It was altogether different from the noise made by the few hundred drones

THIS FRAME HAS FOUL WOOD.
Notice the irregular cappings and the Queen on honey-cells.

TRANSFERRING BEES FROM ONE HIVE TO ANOTHER.

at midday. The Old Queen had swarmed and gone her way ; the guard about the Young Queen's cell was removed, and she was at liberty to move about the hive.

Three days later, after one or two preliminary journeys into the air, she had taken nuptial flight and had returned safe and sound to the hive, bearing with her the trophies of brief converse with a drone that had died in the hour of his victory. She rested awhile from her labours, and then for one day she had laboured over the brood cells, guarded and groomed and fed and flattered by the worker bees who had congregated round the cell in which she was born. Then the cry of three of her imprisoned sisters, challenging her supremacy, roused her to ungovernable wrath, and. this time the workers did not attempt to stand between her and her anger. Sight and smell and hearing all served to direct her to the queens' cells where her imprisoned sisters were still confined in fashion that left the lower part of their bodies exposed. The long sharp sword that was part of her equipment she had used with deadly effect upon the hapless prisoners ; there could be but one Queen. The worker bees dragged out each murdered body from its cell and passed it over to the undertakers of the hive, who bore their burdens as best they could to the ditch that was the common burial ground. A few of the workers round each queen cell greedily devoured what remained there of the bee milk ; then the cell was

scoured and nothing was left save the cocoon to tell of the tragedy that had been enacted.

Thereafter her rule had not been disputed, though it was directed by the worker bees, who had led her in regular order over the cells, determining for themselves what eggs she should lay and of what kind, conscious of their ability to increase or limit the number of drones, and raise more queens if they should wish to do so, by isolating a worker cell and feeding the new-born grub with the richest food in most generous fashion.

A year had passed since then. Another summer was at its brightest, and countless fields of flowers offered their nectar to the bees. The hive was full and prosperous, but the Queen Bee knew that a crisis in her life had come. Quite unbeknown to her the workers had prepared queen cells; the first signs of life were audible there, and she knew that the hour was approaching when she must face rivals, and possibly meet her death. Friends she had none, for in the hive friendship is unknown, duty has taken its place. Very bitterly she had rebuked her courtiers—the workers who had fed her with the richest food as long as it was necessary for her to lay eggs, but had left her when the cold weather came to fare on simple honey along with the rest. She had begged and threatened, but all to no purpose; just as she had been cared for in the early days, so the young queen bees were being cared for now, and at last, in an agony of rage and resentment, she had cried, "To-morrow I will leave the hive, and all who care may follow me."

In a few moments this threat had penetrated every corner of the citadel, stirring even the lazy drones to consciousness of some other interest in life than food or play. The various committees that direct the operations of the hive, supervising the labours of the bees that work the air supply, the sentries, the nurses, the wax makers, the builders, the undertakers, the scavengers, and the drones, held excited and noisy councils. In place of the regular subdued murmur of the hive that told of the even tenor of work, there were countless jarring sounds in different keys and of varying intensity. Among the laws of the hive—known to every worker—was the one that said, "A Queen Bee may swarm if she care to, while if it be the will of the community to supersede her, and she does not swarm, she may be put to death." Very quickly the vast numbers gave their decision and divided themselves up. More than twenty thousand decided to swarm, while the rest elected to remain where they were and appoint the strongest of the young queens to take the Old Queen's place. All through the night various plans were discussed. Only the fanners, upon whose labours the air of the hive depended, remained constant to their task, while with the break of day those who had decided to follow the Old Queen to exile sent scouts out, north, south, east and west, to look for a new home.

After deciding where the swarm would light, the Queen Bee waited anxiously for midday. The cries of the imprisoned queens in their guarded cells awoke in her, every now and again, short, sharp fits of frenzy, but for the restraining guards she would have put the need for swarming beyond further discussion. A spirit of unrest ruled the hive, from the honey cells at the top to the brood cells below and to the alighting board, beyond which the bees responsible for the air current still laboured as though they alone were unaffected by the coming change. Whatever happened the current of pure air must flow through the hive, and so they fluttered their tireless wings while their fellow workers inside the hive, save the few who were generating a contrary draught, seemed to have forgotten the call to the fields and all the wealth that awaited their gardening. The morning waxed bright and glorious, the song of birds and insects penetrated to the heart of the hive, summer called the workers to the field, but for once her summons was ignored by the most of those it reached.

"Prepare yourselves," cried the Old Queen at last, "it is time to go." Scarcely had this signal been given when the clamour died down as though some spirit of peace had descended upon the population. During the next few minutes every bee that had arranged to follow the Queen filled herself with as much of the hive's store as she could carry.

SHAKING THE SWARM INTO A SKEP.

None knew where or when the next meal would be taken or what fortune would follow departure from home. Yet, again, the Old Queen called. "Forward," she cried; and with a mighty rush some thousands of workers left the hive and circled in the air with a great noise of wings and many shrill cries of excitement, pitched too high for any human ear. Seeing her huge cohort leading the way, the Queen moved steadily to the alighting board, stretched her wings that had been unused for so long, and rose into the sunny air, followed almost immediately by her retainers, who had not left her for a moment.

Behind her came the rest of the swarm, and soon these many thousands of sober workers were playing in the sunlight as though they had never known the meaning of toil. They moved in large sweeping flight, much greater than that which served them when they came to and from the fields; and as they went round they sang their own shrill summer song as though they knew that this was for them the one holiday of their life, and that when it was at an end there would be no further respite from labour until work was ended for all time.

At the far end of the orchard a young mulberry tree had allowed one branch to stretch out beyond all the others, and the gardener had allowed it to remain for reasons best known to himself. Hither the Old Queen made her way; the dense swarm moving in large circles round and round her at a pace that made the air as full of sound as sunshine. Gradually the flight of the bees took a circular shape, a living wheel seemed to go round the tree, very large at first, but contracting gradually until in a few moments it had disappeared, and in its place there was one long cluster of bees hanging down in some mysterious fashion from the branch of the mulberry tree itself. The ardour of the swarm had proved of short duration. Once again

intelligence had taken the place of emotion; the original problems of life had taken their place in the bees' consciousness. Now they hung round their beloved Queen almost motionless, waiting upon events. Gradually the scouts, absent since early morning, might have been seen following their aerial roads to where the swarm was stationed, and they shrilled the news of their traffic and discoveries in fashion that communicated the intelligence to the stationary swarm.

From the flower garden where he was at work, the old gardener had seen the exodus and, greatly pleased to see the truants had settled within reach, was moving in leisurely fashion to find a skep in which to hold it. But the skep was right at the back of the toolhouse, and the gardener was no longer active. Many odds and ends had been piled upon the skep, much dust had accumulated in its crevices, and so he took a brush and, in most leisurely fashion, cleaned it and then went to the herb garden to gather a few leaves of thyme and other herbs with which to freshen and sweeten it, for it was the old man's theory that even a skep should be made attractive and pleasant to the bees. His work completed, he moved at last in the direction of the mulberry tree. But before he could get within thirty yards of it there was a sudden commotion, the outer circle of bees began to fall off and fly round. The circle enlarged again rapidly; the whole swarm was on the wing, and a moment later was heading off across the valley, leaving the gardener to sit down upon a wheelbarrow and wonder audibly.

There was no occasion for surprise. While the bees were in their cluster under the mulberry shade, the last of the Old Queen's scouts had come bringing news of a hive, clean, sweet scented and empty, in a garden across the valley. She shrilled her tidings of flowers full of fragrance, of a wealth of pollen and nectar inexhaustible, and told how beyond the garden there was a field full of ripening white clover. Such a prospect removed all need for further consideration. Perhaps some shrewd but unscrupulous beekeeper, knowing that swarming time had come, had made his own preparations for it; and now the swarm was across the river and over the plantation that intervened between their old home and the new.

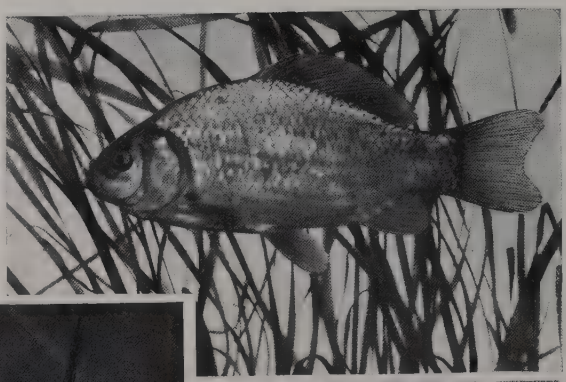
HOW TO KNOW THE COMMONER POND AND RIVER FISH

By STANLEY C. JOHNSON, M.A.

With Photographs by STANLEY and WALFORD JOHNSON

IN differentiating between the various fresh-water fish that commonly inhabit Britain, most confusion is likely to arise with the members of the Carp family. The typical representative of this group is the Common Carp, a fish that was extensively cultivated by the monks of the Middle Ages as an article of diet, and is now largely eaten on the Continent, especially in Germany. It is best recognised by the muzzle, which is blunt, rather small, with hanging barbels. In colour it is a rich greyish-brown. Two interesting varieties of this species are the Mirror Carp and the Leather Carp. The former has shining scales some four times the normal size, which are arranged usually in three rows running from head to tail; the latter is almost devoid of scales, its unprotected skin being the only covering.

A better-known member of this family



PRUSSIAN CARP.

PIKE PERCH.

TENCH.

RAINBOW TROUT.

is the Prussian Carp, a fish which may be distinguished readily from the Common variety by it possessing no barbels and being of a richer and less greyish-brown. The Prussian Carp inhabits still, muddy waters, burrowing in the bottoms of the ponds or rivers for vegetation and smaller animal life. It is extremely hardy and often lives to a considerable age. The Goldfish, with which we are all acquainted, is merely a coloured variation of this species.

ROACH (HAS RED EYES AND FINS).

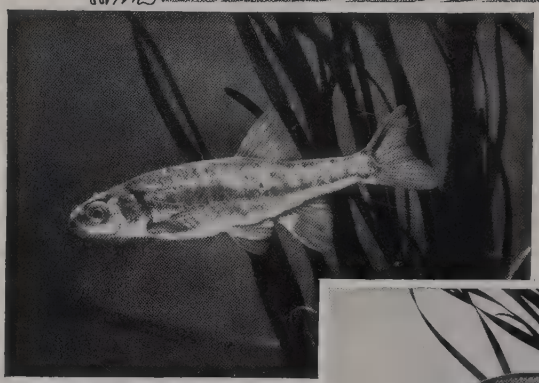
Four very confusing fish are Roach, Dace, Rudd and Chub, being similar in build and almost identical in habits. The Roach is the thickest set of this silvery quartet, having red eyes and, when matured, reddish fins. The Dace is of a longer and thinner type, and may be distinguished readily from the Roach in that its eye is not red. The Chub is very much like the Dace, but the anal fin in the former is convex, whilst in the latter it is clearly concave. The position of the dorsal fin enables us to differentiate between the Rudd and the equally broadly built Roach. With the Rudd this fin is situated midway over the anal and ventral fins, but just above the ventral fin in the Roach. All these fish prefer clear running streams, where they may be found swimming peacefully together in large shoals.

GUDGEON.

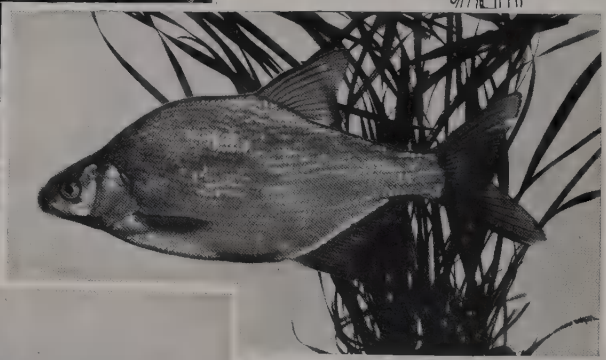
The Tench claims some relation to the Carp family. A somewhat heavy fish, it is slightly lethargic in its habits, preferring to lie hidden in the muddy bottoms of stagnant pools during the day and only venturing forth at night to secure its supply of insect and plant food. It is of an unmistakable olive-green colour, sometimes tinged with a blackish sheen. The fins have rounded edges and the scales

DACE (*LEUCISCUS VULGARIS*).

PIKE.
Note how the stripes help to confuse it with the weeds.



MINNOW.



SILVER BREAM.
Note unusual length of anal fin.

COMMON RUDD.

are unusually small. Like most of the Carp group, it can live for an extended period out of water if only it is wrapped loosely in a little wet moss or weeds. The Golden Tench is an acclimatised variety often met with in ornamental waters.

Of the Breams, there are two kinds ordinarily found in British rivers. The commoner species is the Silver Bream, a handsome bluish-white fish having a deep body with a comparatively small head and an unusually long anal fin. It is remarkably narrow in width, and on this account often goes by the name of Bream Flat. The second variety, the Pomeranian Bream, is thicker set, and has a yellow iris to the eye. It is usually considered to be a hybrid between the Continental Bronze Bream and the Roach. All Bream grow rapidly, and are of a hardy nature; they swim in shoals and feed largely on worms.

The Bleak is a silvery fish that may be recognised from the Dace by its long, almost Bream-like, anal fin. Its scales, we are told, were formerly used in making artificial pearls. It is a gregarious little fish, and is frequently found swimming in shoals at the surface of streams on the look-out for insect food.

Another variety distantly related to the Carp is the well-known Minnow. Having a large eye, a somewhat mackerel-like pattern on its scales and an incomplete lateral line, it should be easily recognised. It is not nearly so common now as it was a few years ago, as millions are annually netted for live bait.

Gudgeon also belong to the Carp family, having the barbels characteristic of the Tench and the Common Carp. Not only are their fins deprived of spines, but they are also speckled, a point which should readily assist in effecting their identification. Gudgeon haunt the shallows of rivers, especially in bright sunny weather; their protective mimicry is then unusually clever.

Turning to quite another family we come to the Perch group, in which we shall include the Perch proper, the Pike Perch, and the Pope or Ruff. All the members of this class possess spiny rays in the dorsal fin which, when stiffly erected, afford a suitable protection against the greedy propensities of such water pirates as Pike. The Perch is one of our finest-looking fish, being of a slaty-green lustre with six transverse stripes of brown and bright red under fins. Its spawn, which appears late in spring, is eagerly sought after by wild-fowl and swans; it is laid in long gelatinous bands somewhat similar to that of the toad, and may be found not far below the surface of the water, clinging to the weeds and rushes. The Pike Perch is a narrow, worried-looking fish of quick, alert movements; its capacity for swallowing large morsels of food is only equalled by that of the snake. The Pope or Ruff is of Perch-like build, but in more drabby colouring; it may be recognised as having the trait of two dorsal fins joined into one.

PERCH (*PERCA FLUVIATILIS*).

Pike belong to quite another class. Their long, barrel-shaped bodies of mottled brown and green closely resemble floating twigs; they are thus able to approach their victims without arousing suspicion.

The Stickleback is an ally of the somewhat romantic Flying Fish as well as the Mullet and the Seashore Blenny. Its pugnacious habits are the cause of much mischief to itself and its neighbours, whilst its greediness for the fry of all kinds of fish must have a far-reaching effect.

HEATHER.

HOW TO KNOW THE FLOWERS OF THE MOORLAND—I

By the Rev. H. PUREFOY FITZGERALD, F.L.S.

With Photographs by HENRY IRVING

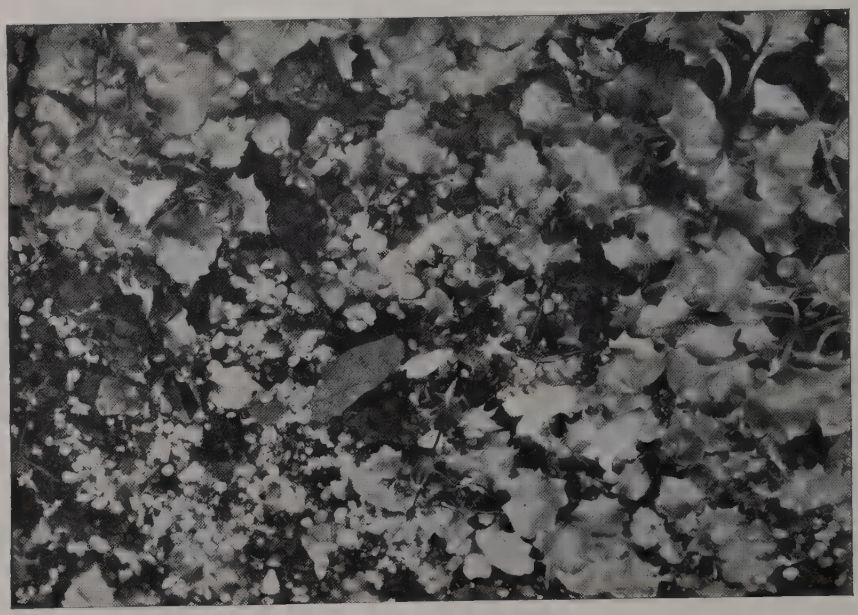
THE word moorland is a pleasing one, it suggests freedom and space, and where many delightful rambles may be indulged in, the air seems to be better than in most other places, and one's spirits seem to rise as one goes farther and farther away from human habitations. It is not everywhere that these large uninhabited tracts of country are to be found, but generally there are a few acres of wild wastes, which might be described as moorlands in miniature, and even these will supply us with certain plants which are typical of such places. One fact may be noted here which illustrates the methods which plants employ of adapting themselves to their environment; most of them (excluding all those found in the boggy places) protect themselves from loss of water in some way or another, some of them by having their leaves rolled up, so as to expose less surface for evaporation, in others the leaves fall off very early. On the wind-swept moors it is essential for the plants to do something of this kind, else when the drought comes it might fare badly with them.

HEATHER

The Heather, or Ling (*Calluna vulgaris*), is often confused with the Heaths or Bell-flowered Heathers, although the difference is somewhat great. In the Ling, for instance, the leaves are very short and placed in pairs opposite to each other, and also the purple corolla is shorter than the calyx, which is also coloured; the flowers, too, are arranged in small clusters all along the stems. In the Heaths, or Bell-flowered Heathers, the coloured corolla is always longer than the calyx, and the leaves are arranged in threes or fours along the stem.

The Ling is a member of the Ericaceæ, a family which includes many beautiful plants, such as the Azalea, Rhododendron, Arbutus, and Kalmia of foreign climes. Great use is made of the plant for thatching, making brooms, and so on, and it is only where the Heather grows that grouse and other moor game birds can live; the honey collected from its flowers has a great reputation, it is of a dark colour, and has a very distinctive flavour. The names Heath, Heather, and Ling all appear to come from old Anglo-Saxon words connected with heat and fuel, implying that these plants were used for firing in ancient days.

CROSS-LEAVED HEATH.



IVY-LEAVED BELL-FLOWER.

Few people that have seen a large tract of country during August and September with the Heather in full bloom, varied with the lighter tints of patches of other Heaths, will forget the wonderful colouring effect; there are few sights in Nature more striking.

CROSS-LEAVED HEATH

The two common species of Bell-flowered Heathers are the Scotch Heather (*Erica cinerea*) and the Cross-leaved Heath (*E. Tetralix*). There need be no difficulty in distinguishing between them if the following points are remembered. The Scotch Heather has its leaves arranged in threes along the stem, whereas in the Cross-leaved Heath the leaves are in fours; again, in the former the flowers are of a reddish-purple colour densely arranged on the upper parts of the flowering stems, whilst in the Cross-leaved Heath the flowers are pink and in small clusters at the extreme ends. Attached to the pollen-bearing anthers in the latter are long, awn-like appendages which are absent in the Scotch Heather flowers. The stems of *E. Tetralix* are very wiry, and the whole plant is covered to a varying extent with downy hairs. In olden days, in Scotland, these plants were used as badges of certain clans—the Macdonalds took the Cross-leaved Heath, the Macalisters the Scotch Heather, and the Macdonnells wore the Ling. Two other species are to be found growing in England, but they are very rare, whilst Ireland can boast of three more.

WHORTLEBERRY

Growing in hilly heaths, woods and moorland tracts the Whortleberry (*Vaccinium myrtillus*) will be found fairly common; it also rejoices in the names of Bilberry, Whinberry, and Blaeberry. Formerly it was placed in the Heath family, but on account of some slight differences it, with a few relations, now forms the family of Vacciniaceæ.

The Whortleberry is a small shrub, growing nearly a foot in height, with several green, spreading branches; the leaves have very small stalks and are deciduous, falling off in the early autumn; they are toothed freely round the edges, and in this respect differ from the smooth leaves of the Bog Whortleberry (*V. uliginosum*). There is another noticeable difference between the two, in that the stems of the former are angular, whilst those of the latter are round. The Bog Whortleberry is not found excepting in the extreme north of England and in Scotland. The globular, greenish-white

flowers, with a slight tinge of red in them, grow singly on short, curving flower stalks, which spring from the axils of the leaves of the year's shoots; these are succeeded in the autumn by round, nearly black berries with a beautiful bloom on them—they are crowned by the four or five teeth of the calyx. The anthers of the stamens will be seen to bear two little awn-like appendages, somewhat similar to those found on the anthers of the Cross-leaved Heath, but a good deal bigger. The Cranberry (*Oxycoccus quadripetala*) is a near relation to the Whortleberry; it grows in peat bogs, and although it is fairly widely distributed throughout the British Isles, it is not very common, and owing to the drainage and reclamation of waste lands it is becoming less plentiful than formerly.

WHORTLEBERRY.

IVY-LEAVED CAMPANULA

Down near the rills on the moors and on the banks of streams in woods one of the most delicate-looking of our flowers will be found—this is the Ivy-leaved Bell-flower (*Wahlenbergia hederacea*). This little plant grows gracefully in a prostrate position, its stems and branches being not much thicker than a coarse thread; the bright green leaves are heart-shaped, and generally have a few angular teeth round the edges. The flowers are borne on threadlike stems, there being one flower only on each stem, and are of a delicate bluish-purple colour, about half an inch long and bell-shaped; when in the bud they droop, but become erect as they expand, and then often droop again as the fruit ripens.

This little Bell-flower is exceedingly attractive in appearance, and forms very graceful festoons around the stones and twigs amongst which it is growing.

H. PUREFOY FITZGERALD.

TWO COMMON THISTLES

By BENJAMIN HANLEY

With Photographs by the Author

IN Britain we have no lack of thistles of various species, and of these without doubt the most common is the Creeping Thistle (*Cnicus arvensis*), and one might say without fear of contradiction it is the most disliked—by the agriculturist especially—for whereas most other thistles, which live only two years, can be dealt with by cutting down either before flowering or before the seed is ripe,

SPEAR PLUME THISTLE.

and so prevent the thistle-down flying far and wide, this species spreads underground, and the more one cuts it down the more fresh shoots appear in new places.

This habit, which has earned for the plant its name, may be best noticed in the early part of the year, when the plants are only a few inches above the soil, for then patches many yards in area will be seen studded with young plants, and it is easy to tell that they have all sprung from one root. The male and female flowers are borne on separate plants. The former are rounded and the latter long and narrow. Another thistle almost as common as the last is the Spear Plume (*Cnicus lanceolatus*), but this is a much finer plant. It has received the first part of its name from the prickles on its leaves having developed into long, sharp spines, and if one stumbles upon a plant unawares no doubt the name will be thought appropriate. The flowers of this thistle, purple in hue, are much larger than those of the Creeping Thistle; the heads will measure an inch across. They are dearly loved by the humble-bees, which work early and late extracting sweetness from the nectared florets; sometimes indeed they fall asleep on the flower-head, and thus one finds them, drenched with dew, in the early morning, quite unable to fly until the sun has dried the moisture off them.

The name "Plume" Thistle is given because the hairs which compose the thistle-down are feathered, or plumed, whereas in the true thistles they are simple hairs.

Long before the majority of plants show any signs of life, this thistle may be seen spreading its leaves in green rosettes; and in late summer, crowned with a wealth of bloom, it forms one of the most striking objects of plant life.

BENJAMIN HANLEY.

CREEPING THISTLE.

SUNSET ON THE BAY.

From the Water-Colour Drawing by W. Telbin.

IN THE GLOXINIA THE PETALS ARE ALL JOINED.

CHAPTERS IN PLANT LIFE

VIII—THE EVOLUTION OF THE FLOWER

By S. LEONARD BASTIN

With Photographs by the Author

IN a general way, without the system of organs to which has been given the name of flower, the blossoming plants could not continue to exist. Of course, there are exceptions where plants producing flowers are not entirely dependent upon the offices of the floral organs for the perpetuation of their kind. Naturally, all annuals rely entirely upon increase by seed, but there are a few known cases in which perennial plants have persisted in a locality, and extended their field of growth, without ever having been known to propagate their kind through floral agency. The most singular instance on record is that of a little Oxalis introduced into Malta from the Cape before the year 1804. The species has spread along the shore of the Mediterranean by means of bulbs, but has never yet been observed to set seed in Europe.

A more homely instance of a plant which is practically non-seeding is to be found in the Lesser Celandine—a species which only on the rarest occasions produces fertile seed. The common mode of increase adopted by this plant is to be observed if the axils of the leaves are examined just after flowering time. In each recess there will be found a curious little tuber

about the size of a grain of wheat. These will subsequently fall to the ground, and, taking root, produce new plants. We must regard instances such as these as exceptions to that which is the rule amongst plants producing flowers.

Seeing that the flower is such an important feature of the plant, it is a matter of interest to consider the relations of the blossom to the other parts of the typical specimen. For the present purpose it will be all-sufficient to think of the flower as consisting of four parts. Starting from the outside of the bloom, we find the calyx ; this consists of a number of sepals, which may be green or coloured. Enveloped in the calyx is the corolla formed of a number of petals usually coloured to a greater or less degree. In the centre of the flower we shall find a number of stamens, these enclosing in their turn the group of carpels which go to make up the pistil. As well, in not a few flowers, there are present a number of external appendages to which has been given the name of bracts.

BOUGAINVILLEA, AN INTERESTING PLANT WITH LILAC COLOURED BRACTS ROUND INSIGNIFICANT FLOWERS.

It has been stated that the calyx of the flower is in some cases green, whilst in other instances it is coloured and petal-like. To state that the sepal is green is the same thing as saying that the organs to an extent perform the functions of a leaf, and it is interesting to see whether it is possible to trace any further connection between the calyx and the foliage of the plant. The herbaceous Pæony is well worth an examination with this problem in mind. If a number of specimens of this flower be examined, it will be found that quite often the sepals of the calyx are modified leaves. Indeed, time and again it is impossible to determine definitely the exact nature of the organs, and the confusion is all the greater when, as is often the case, a large area of the leaf-like sepal is as gaily coloured as a petal.

In the common Moon Daisy of the meadows we may trace the whole course of the evolution of the green bracts which encircle the mass of ray florets. If one of the long-stemmed blossoms be examined, it will be found that, starting from the base, where there are the typical leaves of the plant, we shall find that there is a steady decrease in the size of the foliage as we approach the flower head. Finally the green processes lose their distinctive form altogether, until just below the flower they drift into simple lobes, which bear a striking resemblance to the bracts that encircle the flower.

We can thus trace a definite connection between the sepals of the flower and the foliage of the plant. Going beyond this, it is not a difficult matter to find a distinct relationship existing between the calyx and the corolla. The Tulip is an excellent case in point, for except that the sepals are, of course, on the outside of the petals, there is really nothing to distinguish them. Now, if we observe a large number of cultivated blossoms we shall certainly find that in not a few cases the sepals are partly or wholly green, proving beyond a shadow of a doubt whence they have their origin. Perhaps a still more striking proof of the leaf

origin of both sepals and petals is to be seen in the flower of the Summer Snowflake (*Leucojum æstivum*). Each portion of the perianth is tipped with a dot of pure green, and this spot stands up in vivid contrast to the snowy whiteness of the organ. For what special purpose this conspicuous marking of green may have been retained it is not easy to say ; it is all-sufficient to indicate to the student the leaf ancestry of the sepals and petals.

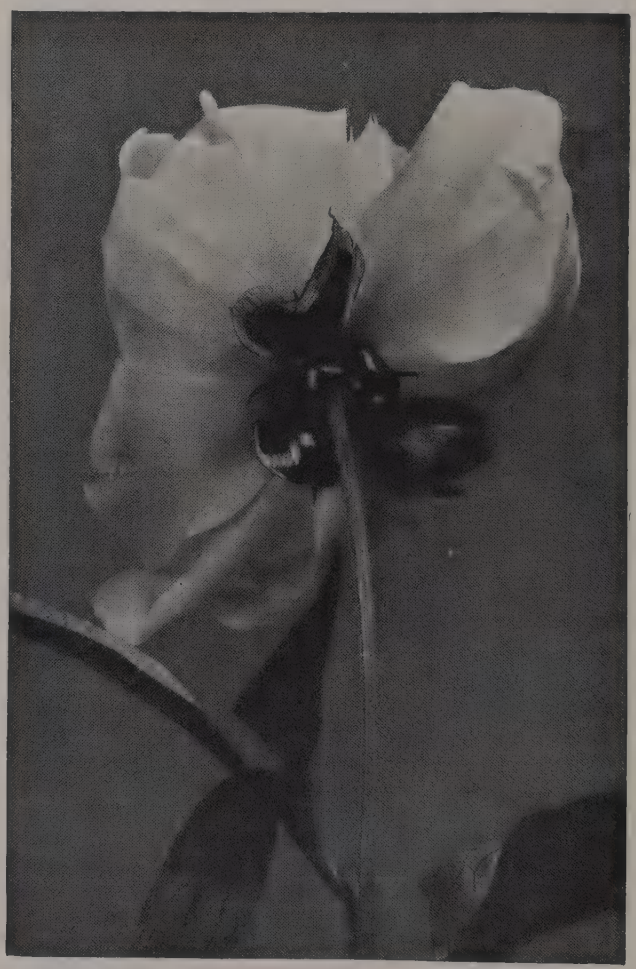
A singular example of a plant belonging to an advanced family which has not found it necessary to produce any coloured sepals or petals for its flowers at all is to be seen in the Green Rose (*Rosa viridis*). As the name of the plant suggests, it is entirely without any tinted blooms, all parts of the flower being in the form of small green processes. If examined closely the organs are seen to be nothing more than diminutive leaves, and these even go so far as to retain the toothed edges which are such familiar features of rose foliage.

LEAF-LIKE SEPALS OF TULIP.

The change of the leaf into a tinted sepal or petal is not, after all, such a very remarkable happening, for coloured leaf-like organs which exhibit their character in all respects save that they are not green, are not uncommon. One of the most striking plants exhibiting this change of colour in the leaf is the *Bougainvillea glabra*, examples of which are to be seen fairly often in greenhouses. The real bloom of the Bougainvillea is insignificant, nothing like so striking in appearance as our Cowslip. They are developed in clusters of three, and being of a pale yellow, would scarcely be noticed amongst the foliage were it not that each group is enveloped by three conspicuous bracts. These bracts are closely on the lines of leaves, but are tinted in a highly attractive shade of lilac. As has been indicated in an earlier article, the Bougainvillea is well able to attract the attentions of insects by means of its showy appendages. A more familiar case of extra floral coloration is that to be seen in the *Salvia horminum rubra*, a common garden species.

This plant has adopted strange means to advertise the presence of its small labiate flowers. When in bloom the terminal leaves of each spike of this Salvia are tinted in the brightest pink. There is no doubt that these processes are true leaves, seeing that when traversing the whole of the stem it is possible to find leaves which are half green and half pink.

Further proof that the petals and sepals of the flower have their origin in the foliage of the plant is to be seen in the case of those species in which the calyx or the corolla persists after the blossom is "over," and for a time practically performs the offices of leaves. Thus with the Christmas Rose the petal-like sepals which go to make up what one may call the corolla, are peculiarly tenacious in retaining their position on the stem; they do not fade away after the maturity of the essential organs, but lose their whiteness and become green and leaf-like in appearance. Much the same process goes on in the case of the Hydrangea, a plant which, it is well known, surrounds its inconspicuous flowers with showy bracts. These bracts remain for a long time after the flower has faded, finally becoming as green as the leaves of the plant itself. Moreover, there are certain species of plants in which the coloured parts of the flowers gradually develop from very green material. This is seen in the case of some of the Guelder Roses (*Viburnum*), where the undeveloped floral appendages practically perform the offices of leaves during the early stages of their existence.



IN THE PÆONY THE LEAF ORIGIN OF THE CALYX IS CLEARLY SEEN.

The conspicuous and often attractively coloured sepals and petals of the flower are, after all, but of small importance when compared with the organs which go to fill up the centre of the typical bloom. We may, perhaps, regard the calyx and corolla in the light of advertising agents whose business it is to spread abroad the knowledge of the existence of the concern which they envelop. As is so well known, the essential organs of the plant consist of the stamens and carpels, these latter forming collectively the pistil. It is the duty of the stamens to produce the pollen grains, which, coming into contact with the ovules in the female portion of the flower, bring about the process of fertilisation. If all goes well the outcome of this union is the seed—the forerunner of the new plant.

It may not seem to be a particularly easy matter at first sight to determine what

may be the origin of the specialised male and female organs of the plant. As we have seen, both the sepals and petals of the flower show a more or less striking resemblance to the foliage of the plant, but one can scarcely say that there is much obvious connection between stamens, pistil, and leaf. None the less is it a fact which can be easily demonstrated that the leaf was the ancestor of even the reproductive organs themselves. In this connection the case of the so-called "double" flowers is very instructive. Here we see that the peculiarity of the blossom consists in a great increase in the number of petals, and these organs must have had their origin in something; as a matter of fact, they are degenerate stamens. The manner in which this change of stamens into petals takes place may be often well seen in the case of Begonias. It has been found to be almost impossible to establish an entirely double strain of these flowers owing to a strong tendency to revert to a single condition. Very commonly blossoms are to be found in a curious midway stage between the double and single condition, and when this is the case an interesting sidelight as to the connection between stamens and petals is to be seen. Some of the abnormal organs then produced are simply flattened stamens, very much like miniature petals save that the extremity is covered with a deposit of pollen. In other cases there is no pollen at all, and the process is formed of coloured tissue, being in fact a perfect petal on a miniature scale.

THE SNOWFLAKE, SHOWING GREEN TIPS ON FLOWERS.

Probably one of the most remarkable object lessons to be found in the vegetable world bearing on the origin of stamens is to be found in the case of the flower of the White Water Lily (*Nymphæa alba*). If a well-developed specimen is secured and carefully dissected, it is possible to sort out a most instructive series of organs illustrating the stages between the perfect petal and the normal stamen. Commencing

with the outside of the flower, we find the green sepal, which, in passing, it may be pointed out, is partially tinted with white. Next we shall find several rows of well-formed petals, the only strange point about these being that they steadily decrease in size the nearer one gets to the centre. If the investigation is pushed still further, it will be found that the petals become even more narrow, until they are strange linear processes which it is difficult to call by any name. At last one will be discovered which appears to be curiously thickened at the point, and if the termination of the organ be closely examined the presence of a small amount of pollen may be detected. The termination of this process, which can be called neither petal nor stamen, continues to be more and more modified as we near the centre of the flower, until it is resolved into two thickened parts, to be recognised as the anthers. When this stage is reached the petal-like lower part disappears and a slender thread takes its place, thus forming the filament, which goes to the making of the typical stamen. In the central rows of stamens it is not possible to discover the least resemblance between the petals and the male reproductive organs.

The Water Lily is not the only flower in which the intimate connection between the petal and the stamen may be traced. Something on much the same lines is to be seen in the case of certain species of Pæony, and other instances might be brought forward. It will hardly be necessary to bring forward further proof that the relationship between stamens and petals is a fact beyond question.

It will not be quite such a simple matter to trace in a clear fashion the leaf origin of the pistil as it has been in the case of the three other organs which have been dealt with. It sometimes happens in freak flowers that the stamens are transformed into carpels, and even on occasion strange processes have been found which bear a resemblance to both male and female organs. In the case of an abnormal Saxifrage mentioned by Kerner, it appeared that the anthers and ovules can be produced from exactly the same part of the stalk. There is, therefore, without doubt, a close connection between the stamens and carpels. It is interesting to push the matter still further and endeavour to find out whether we cannot find in a more direct way that the pistil is akin to the leaf.

There does not seem to be any flower in a natural state which offers us a complete explanation as to the origin of the female organs. Even in the case of most double flowers it is not easy to find an instance which helps us to understand the evolution of the carpels. There is, however, one double blossom which lets a good deal of light on to the problem, and this is the Cherry. The flower will well repay anyone who is interested in the matter to study a little closely. If the inner petals of a well-developed bloom of the double Cherry are torn away, it will be found that a small leaf occupies the place of the usual carpel. This leaf has the two edges folded towards each other, and the midrib is greatly prolonged, having a little knob at the summit. Now if this process be compared with the normal carpel of a single Cherry blossom, it is quite easy to see that the two sides of the leaf represent the walls of the ovary, whilst the elongated process can be none other than the style.

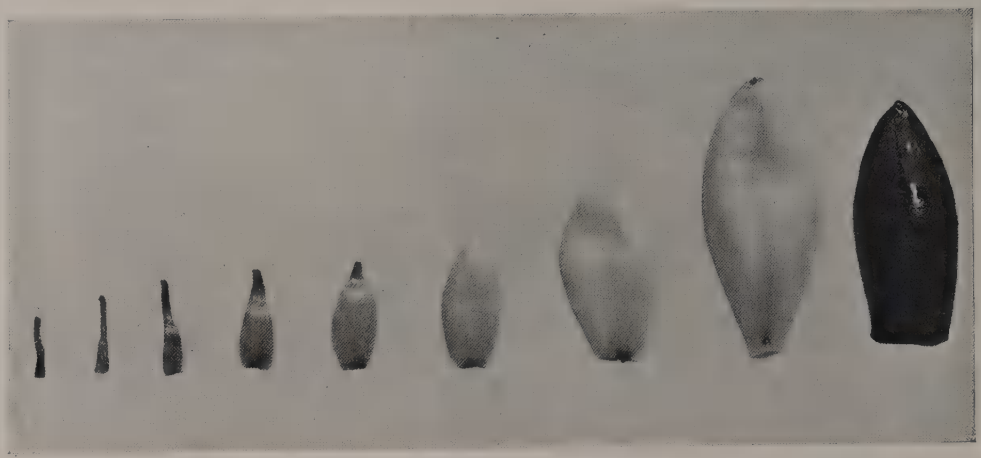
When the carpels have passed their maturity it is not at all an uncommon thing for them to develop into very leaf-like organs. This is the case in the seed vessels of the Pea, where it is discernible that the two sides of the pod are not unlike the lobes of a leaf joined together by a midrib. A most suggestive monstrosity is occasionally seen in the case of the Pea pod. This happens when for some reason the ovules fail to develop and the two sides of the pod do not close together in the normal fashion. When this is the case it is seen that the lobes of the seed vessel are still more leaf-like than is usually the case. Small projections are to be observed along the edges of this process, which may be called the carpellary leaf, and these will show where under ordinary conditions the ovules would have been.

For purposes of convenience the different parts of the typical flower have been dealt with in the order in which they occur in the actual specimen when a start is made from the outside. By doing so it has been made clear that every part of the flower has a most intimate connection with any other portion. In every case one

was brought back either directly or through some other organ to the leaf as the origin of that particular portion of the flower. It is quite certain that the foliage of the plant must have been in existence prior to the blossom, for whilst flowering plants can persist without blooms, they could not live at all without foliage or its equivalent.

The question as to the order in which the various parts of the flower were evolved is a most important one. Though the matter is still a controversial one, it is sufficiently obvious that the first portion of the flower to be formed could scarcely have been the calyx, the next the corolla, and so on. It cannot be advanced that these organs, which, after all, are only appendages, could have been formed in advance of the reproductive portion. As we have seen in an earlier chapter, the main object of the brightly coloured corolla seems in every case to be the means of advertising the presence of the essential parts of the flower, in connection with the scheme of fertilisation. Flowers with sepals and petals, but lacking the reproductive processes, are, of course, unknown in Nature, whilst there are many instances in which the corolla is quite absent. One cannot well escape the conclusion that

CURIOUS BEGONIA BLOOM.
The stamens in the centre degenerate into petals.



THE RELATION BETWEEN THE PETALS AND THE STAMENS OF THE WATER LILY IS HERE WELL SHOWN.

the stamens and pistil were developed from the leaf in the first instance, the protecting calyx and the inner row of petals coming later. If this argument be correct, we should call the midway organs which have been noticed in the Begonia and the Water Lily as degenerate stamens rather than as developing petals.

The subject of the evolution of the flower is a very profound one, and it is not possible to do more than hint at the wonderful process whereby the different parts of the blossom have been developed. To the general observer the most significant point is the manner in which at every turn one is brought face to face with the great importance of the leaf in the economy of the plant. It is in the leaf that the wonderful manufacture of the life basis of the plant—the green chlorophyll—takes place. It is from the base of the leaf-stalk that nearly all extensions of the plant arise. Not a few plants are able to produce fresh specimens on their foliage, whilst of course many of the low forms of vegetable life increase in no other way than by a system of leaf extension. We shall not be far wrong in regarding the leaf as the most important organ of the plant.

In considering the foregoing instance the student can scarcely fail to have been struck with the importance of those examples which are in some way departures from the normal. Certainly it seems that as the great scheme of evolution goes forward, the traces of the origin of things become less and less distinct. It will well repay anyone who is interested in the subject to keep a sharp look out for freak flowers, for, as we have seen, it is most likely that in these forms we shall find enlightenment as to the beginnings of the floral organs. The observer will find a much more fruitful ground for observation in the garden or greenhouse than out in the country. It is a well-established fact that under cultivation both animals and plants are much more prone to vary than when they are in a state of nature. We are not very clear as to the reason for this tendency, but the fact is beyond dispute. One of the most remarkable cases which has arisen as the result of cultivation, having a bearing upon the evolution of the flower, is the variety of Campanula known as the "Cup and Saucer." As in the case of the Gloxinia, which is illustrated, the five united petals go to the making of one bell, the five sepals being more or less joined together, but, of course, external to the corolla. In the form under notice it is the joined petals which go to the making of the cup, whilst the broad, flattened-out, abnormal calyx is responsible for the saucer. In this case the sepals have lost their green tinting, and have become blue or white as the colouring of the corolla may be. These matters show how important it is that the breeder of new kinds of plants should be acquainted with the scientific aspect of his work.

GREY MULLET.

FISHES OF OUR SEAS

Their Home Life

By F. G. AFLALO

II—BASS, GREY MULLET, GURNARD AND TURBOT

THE notion of any sort of home life in such restless, cold-blooded creatures as fishes may at first sight seem inadmissible. Yet some of us, who, for pleasure or otherwise, have made something of a study of fishes in their natural surroundings, know perfectly well that they can be domestic like other animals, and that their lives are governed by much the same passions and emotions. They are, in fact, actuated by hunger, fear, love and all the other incentives common to the lower creation generally. Of course, they have no moral code. Neither, for the matter of that, have many beasts and birds, save in the fertile imaginations of those who profess to write their life histories. Might is right in the world of waters. The stronger preys on the weaker, and the weaker must either hide or get away if he wants to escape destruction. They are not, however, devoid of what we call the domestic virtues, and parental affection is recognised in many of them.

The Sticklebacks and Gobies will guard their nests or eggs with great devotion, and the Lumpsucker, an ungainly-looking fish, will mount sentry over its eggs with such determination that not even the ebbing tide takes it from its post. It is foolish of the female to lay her eggs so near low-water mark, but perhaps she knows that her husband, and not herself, will run the risk of suffocation. Sometimes masses of these eggs are scattered by a storm, and the breaking of the waves is so violent that the Lumpsuckers cannot keep their place in the shallows. On such occasions, they have been seen, in the ensuing calm, hunting about for the lost eggs with every sign of distress. It has been said that the Lumpsucker even carries its young, clinging to its slimy sides, to places of safety, but the evidence on which this rests is not satisfactory.

In an earlier article attention was drawn to some types of wandering fishes, whose travels are perhaps more interesting than their home life. Now, however, it may be interesting to set down a few facts, as far as we know them, in the life story of the stay-at-home kinds that lack either the inclination or opportunities for extended travel. The Bass, the Grey Mullet, the Gurnard and the Turbot appear satisfactory representatives of these.

The Bass is sometimes regarded as a migratory fish. It is not found on the same grounds throughout the year. In a Devonshire river, for example, on the banks of which I have lived for some years, it is caught only in the warmer time of the year, say from April until September. Yet I long suspected that its change of quarters was only local, and that, instead of travelling hundreds of miles, like the Mackerel and Herring, it moved only from the deep to the shallow water and back again. This belief has more recently been confirmed by a study of the Bass in Turkish waters, where this fish attains to a far greater weight than with us, specimens of thirty pounds being not uncommon in the markets. One gentleman, an enthusiastic Bass fisherman who resides at Constantinople, catches these fish all the year round, only in winter he has to seek them in deeper water, that is all. Like many other fishes, these Bass go in shoals, those of the same size remaining together. They ascend rivers,

GURNARD.

BASS.

not like Salmon, for the purpose of laying their eggs in the gravel beds, but merely in pursuit of sand-eels and other food. In the Arun they wander for miles, as far, in fact, as the tidal limit, for they are caught above Arundel, amid scenes more suggestive of the haunts of Roach and Bream. They also love to play at the surface round rocky headlands, to rout in the fine gravel off sloping beaches, and to hunt for small shrimps and fishes among the wooden piles of piers and quays. They are not always very keen-sighted, and I have seen hundreds rushing up the river at Barmouth, passing by great swarms of unseen sand-eels playing about in the water less than a hundred yards away.

The Bass is a fish of warm seas, reaching its greatest perfection in the eastern Mediterranean. As far as our own coasts are concerned, it is abundant only in the south. North of the Thames and Bristol Channel, it is never plentiful, and in Scotch waters it is a rarity.

The Grey Mullet is a fish of very different habits—no dashing robber like the Bass, but a peaceful vegetarian delighting in weedy backwaters and regularly repairing year after year to piers or harbours where it can reckon on waste peas, potatoes and other soft food. This is why the jetty at Margate is such a favourite spot for its capture, for it regularly frequents the sea under the restaurant all through the summer, and very fine specimens are caught by resident anglers who have studied the conditions. The Grey Mullet, though essentially a sea-fish, can exist in brackish water, but it lays its eggs in the sea only. It grows to a weight of ten or twelve pounds, and is a nervous fish of slow movements when undisturbed, though quick to escape danger and a determined fighter when hooked. It has some extraordinary habits, of which the fishermen are not slow to take advantage with a view to its capture. Thus, it will not pass under a shadow, and the Turks catch it by spreading mats on the surface of the water on moonlight nights and drawing these gradually to land. The shoal is first seen and matting, perhaps a hundred yards long, is spread

over the water, with a fisherman at either end. If the water is deep, a boat at each end of the line answers the same purpose. The frightened Mullet steadily refuse to pass under the shadow of the mats and, dashing wildly to and fro, are gradually brought to the shallows. Then, just as they are nearing the dry land, they make a desperate attempt to jump over the obstacle and land in hundreds on the mats, from which they are easily discovered. Mullet are also, like cows, fond of rubbing their sides against posts, and of this weakness, too, advantage is taken by the fisherman wading at night in the shallows where these fish are commonly found, kicking up the sand so as to thicken the water, and then digging his heels deep into the ground, so as to make a hole rather wider than his leg. Presently he feels a Mullet rubbing against his ankle, and he must then stoop very quietly, get his hands round the fish and, with a sudden grip, lift it out of the water. Thus do the fishermen of the East (who know some things unsuspected in the more civilised West) manage to catch this most suspicious of fishes !

The Gurnard—there are many different kinds, but one will do for illustration—is a striking fish, brilliant red, and with an enormous head. It passes most of its life at the bottom of the sea, on the sand, but now and then I have caught one quite near the surface of the water. The lateral line is very conspicuous in the Gurnard, and one of the fins has tips which have been compared to toes. Indeed, all the Gurnards may be said to walk on the bottom of the sea, feeling their way cautiously among the stones and weeds, and instantly detecting the presence of the worms and shrimps on which they prey. They are lazy fish, and generally take a hook that is allowed to lie quite still on the bottom. Related to the Gurnards are two fishes known as Weevers, which are dreaded by the fishermen of all seas for the venom in their fins. These dreadful creatures lie still

TURBOT.

in the sand, and are caught both in the nets and on the lines. It is when removing them from the nets at night that the fishermen suffer most. Many experiments have been made with Weever venom, which is as active as that in many poisonous snakes.

The Turbot may be taken as the type of a very important group of fishes known, from their shape, as flat-fish. Our own Turbot, which is deep brown on one side and white on the other, is covered with rough tubercles and may thus be distinguished from the smooth Brill. Those from the Black Sea, which I have often eaten at Constantinople, have very large tubercles, and I have noticed these also on specimens in the fish-market at Dardanelles, which is supplied by local nets. The Turbot has no scales. It feeds on many small fishes, among them sand-eels and small flat-fish—and, in fact, fish constitutes its entire food. The spawning time in our seas is between April and July, and a female weighing twenty-one pounds will lay as many as 10,000,000 eggs, the majority of which, however, do not come to maturity. That is why many fishes have to lay such immense numbers of eggs, seeing that, with all the destruction done by storms and other fishes which feed on spawn, the race would otherwise die out—and Nature, as we know, is jealous of the type. Like all other flat-fishes, the baby Turbot has an eye on both sides, and also swims in the upright position. Then, after a few days, it gradually heels over on one side, and the second eye works round to the side henceforth uppermost. It would be of no use whatever on the side that lies in the sand.

NATURE "IN TOWN"

REGENT'S PARK

By ARTHUR SCAMMELL

With Photographs by W. J. VASEY

WHEN the Sun god turns upon his journey, and begins to look with a little more of favour upon this dejected latitude; when germs, many and various, begin to add cell to cell and to put on the dignity of organisms; when bats asleep in the roofs of barns stir in their dreams, and begin to shake the dust of winter from their wings, and squirrels and dormice open their eyes to take another look at the world; then man, too, arouses from his winter lethargy, he has new thoughts, and is impelled to different doings, and—amongst other enterprises—he takes a Sunday morning walk. He is conscious, perhaps, only of a desire for exercise, or he thinks his dog would be the better for a run. But the man is greater than he knows: deep in his subconscious self there lurks a spirit—wild, roving, romantic, artistic, what not—which craves for life and colour and beauty, and so instead of lying long in bed, smoking in his back parlour, or walking the streets, he goes into the park; if he be a North Londoner, into Regent's Park.

One can but regret the name; what is there of beauty or worth that belongs to the Regency? The idea of antiquity is quite cut off; the period was not exactly great in Art, and as for Nature—Nature and the Regency!—the force of incongruity could no further go.

But the man who goes to Regent's Park to-day will see that Nature has forgiven George, and thrown her green mantle of protection over as much of his memory as attaches to the place. Perchance in some two thousand years' time—sins and follies and all else forgotten—the memory

of a mythical prince will live in the odour of sanctity as the founder of this beautiful pleasure ground, which will, of course, easily survive a mere two thousand years.

Our Londoner will enjoy his Park the more if he has a little knowledge of its history, and some imagination. It seems a pity that some brief printed record is not easily available (it might even be posted upon a board at the entrance). The visitor would then learn that in early times the Park formed part of a large oak forest, the property of the crown, and used as a Royal Chase. The oaks—several thousands of them—were cut down in the time of the Commonwealth for navy building; there is not an oak left. The land was afterwards cultivated in three farms until 1811, when the estate was "developed," and the Park formed for the use of the public, "H.R.H. taking a gracious interest in the proceedings."

The oaks are gone, but three large elms in the neighbourhood of the Zoological Gardens are relics of the days of agriculture; they once stood in the farm hedgerows.

The blood of the Anglo-Saxon ploughmen is still thick in our veins; and the idea at least of farming has a strong attraction for most Englishmen, not excepting the inhabitants of London; and so we cannot help feeling regretful for those vanished farms. The taste of "society" at the time would no doubt have scouted the idea, but I am sure that Tom, Dick, and Harry, then as now, would have been glad if something at least of that rustic life could have been preserved—some of the land continued in cultivation as a London farm.

I know that to many thousands of people it would have been a pure delight to walk in a lane, rutty as possible, and bordered with hedges of black and white thorn, dogwood, and hazel, blooming with honeysuckle in its season; from which might be seen the plough turning the crumbling earth, with rooks, belonging to carefully preserved London rookeries, following hard in the furrow; to watch

VIEW BENEATH THE TREES IN REGENT'S PARK.

THE WATER-GARDEN, REGENT'S PARK.

the growth and ripening of the corn, the reaping and the stacking; to have at least one great meadow, where daisies might grow long-stemmed in the lengthening grass, golden with buttercups, and sheeted white with the marguerites of June; then to hear the mower whetting his scythe, to smell the sweet scent of hay, and to see the snugly thatched rick beneath the winter elms. We might have had sheep, not only grazing in the summer, but folded on the frozen ground, and fed with roots from our own mound, and hay from our own rick, and have heard from the snugly littered lambing pens in March the tender cry of new-born lambs.

Was it quite impossible? less possible than the establishment and painful maintenance of tropical hot-houses and sub-tropical gardens, with potted tree-ferns, flannel-swathed palms, and grotesque orchids? At any rate, some of the farm buildings might have been left standing—(and used, one would say, for gardening purposes) weather boarded and red-tiled; with the grace of antiquity about them, they would have pleased us better than the smartest and newest of kiosques, bandstands and pavilions.

It is too late to talk of all this here; conceivably in the laying out of future suburban parks, this very general love of rusticity may one day be considered. Meanwhile we will try to make the most of what H.R.H. and Mr. Nash the architect have given us. Nature has well done her part, and it were ungracious to complain, for here is, indeed, a noble spread of elegant and cultured scenery, beautiful at all times and seasons.

Pleasant it is to enter from the street into a world of green; to see the prospect bounded by tree-tops instead of houses, and to let the sight travel to distant Highgate hill, crowned with lofty trees and loftier church spire; to take delight in undulating masses of foliage, and the bright colours of flowers; to see sheep at pasture under the trees, and eager boys hurrying to their cricket, each one certain of making forty runs at least; smooth, clean shorn lawns in the sunshine, and long grass under the

A LOVELY VIEW ALONGSIDE THE MAIN WALK IN REGENT'S PARK.

trees; to hear the songs of thrush and blackbird, and the coo of the ring-dove; to watch the half-tame squirrel stealing near to the passer-by in hope for crumbs or a nut, all the time with his eyes brimful of apprehension and nimble feet ready for an instant dash to the sheltering tree.

One naturally makes for the most distant part, as promising greater quiet, and the extreme northern side, bordering the Regent's Canal, is perhaps the most countrylike scene that can be found in the Park. A little thread of path runs along by the waterside, and the trees that grow on the steep banks are large and restful; whilst the beams of the setting sun, made more mellow by the veil of London smoke through which they pass, suffuse the foliage and bathe the trunks with golden light. I have seen a sycamore here on a May evening, before the leaves were fully grown, and with its horizontal branches thickly hung with bloom, struck through in a moment by these level rays, and all its yellow clusters lit up with magic fire. The effect lasted but a few minutes, but was of rare beauty, and an example of the "infinite variety" which those will find who watch and wait amongst the trees. An opposite effect of darkness is given by the sycamore in August twilights, when its grand trusses of foliage look sombre and heavy, as if carved out of solid masses of verdure.

There are great ash trees here, but the ash does not seem right to me in a London park; it is an austere, lonely tree, and belongs to remote and silent places, to distant upland pastures, or to the green banks which separate the farthest ploughfields from the downs; grey and orange lichens born of sunshine and pure rains should grow upon its trunk, and the complaining plover wheel her evening flight about its head.

A delicate sense of fitness should direct the planting of a park. There are many and beautiful forms of vegetable life which are quite in keeping with human neighbourhood, and are able to rub shoulders with a crowd with little loss of individuality or charm. The elm as a household tree; chestnuts, limes and sycamores as belonging to the garden;

white and Lombardy poplars (the black should not be grown anywhere), and the plane which has been made free of all our cities. Elder, lilac, and Guelder roses; with all our common garden flowers, except the Madonna lily—these homely things do not lose their quality by being grown in town, and a daisied sward is as right in St. Paul's Churchyard as at the foot of the Grampians. But I do not want to see the ash here, nor the oaks and beeches of the English woodlands, and the pine needs to be rooted amongst crags; these belong to their places like the wild flowers. I will go to them, but they shall not be brought to me; and let that man be anathema who takes the lady of the woods, the silver birch, from the forest and stains her whiteness with city smoke!

Perhaps the most attractive trees in Regent's Park are the wych elms. In the avenues of the central walk they alternate with the common and Cornish elms, assimilating and contrasting with both; for the wych elm is sister to the more familiar and robust *campestris*, graceful where he is sturdy, waving a hundred slender arms where he sends a sturdy column or two skyward. With drooping terminals and large, shapely leaves, a wych elm forms a perfect example of sylvan life and grace.

Two large and beautiful trees growing on the eastern side of the flower garden exhibit all the special characteristics of this species (though the complete and regular manner in which the outer branches sweep the ground may suggest the guiding hand of the gardener); the multitude of long, slender branches, all grace and lissomness; the bark of pure grey, boldly yet delicately carved into a thousand lines of ridge and channel, whilst the luxuriance of its May foliage is enhanced by myriads of leaf-like seed vesicles not yet scattered by the winds. Wide spreading like a forest oak, these shapely domes of verdure, with the long grass around them, and flowering cow parsley beneath their shade, form a picture which draws the steps again and again to this part of the gardens.

The modern practice of planting bulbs in the turf is twice blessed. Not only do we get the first spring green lit up with patches of colour—white and yellow and purple—and afterwards starred with

A MAGNIFICENT DISPLAY OF HYACINTH BULB BLOOMS.

daffodils and jonquils; but when the flowers are gone, there is the long grass, and the flower of the grass, with many of those familiar pleasant weeds which elsewhere are prevented by the too assiduous lawn mower; thistles and dandelions, coltsfoot, sorrel, and here and there the grey-green leaves and upturned eyes of the speedwell.

Regent's Park is honourably distinguished amongst London gardens for the unmutilated condition of its trees. Massive horizontal limbs are allowed to extend themselves even across the walks; and the soaring habit of the elm is not forbidden. Topping and shrouding are almost unknown, and the public are liable to all the supposed danger of falling trees and branches; yet we do not hear of much slaughter.

It is good to know that the present superintendent, Mr. Webster—one of our greatest authorities in matters of forestry—has declared war against these botanical Bob Sawyers, who are all for improving trees into stumps. And as a number of metropolitan gardens, including those at the Tower, the Law Courts, and the Mint, are also under his charge, it may be hoped that for years to come many even of the old and decrepit trees of London, which under less wise management would have suffered, may escape the devouring steel. If only Mr. Webster's arm had been long enough to protect the Wood Street Plane!

Far away lies the country, the land of home; but here are still waters of Babylon to reflect the colours of evening clouds, and willows whereon exiles may hang their harps, and singing birds and bright flowers to alleviate the sorrows of captivity; and, better still, the sight of so many flourishing trees, pleasantly disposed in long avenues and darkling groves, crowning green hillocks and clustering at the water's edge to double their beauty by reflection; whilst in the notes of the birds, and the music of the wind in the branches, our ears may catch sweet echoes of the songs of our far-off Zion.

ARTHUR SCAMMELL.

THE LONG-EARED OWL

By BENJAMIN HANLEY

With Photographs by the Author

BRITAIN is rich in bird life and rejoices in having many species, but of all the birds classed as British there are none more interesting than the Owl family, and certainly none so useful in destroying vermin; yet in spite of this undeniable fact they suffer much persecution, mainly through ignorance, at the hands of people who ought to know better than to take the lives of such useful creatures. The pot-shot gunner, who delights to see birds boxed-up in a glass case rather than to study and watch them in their natural haunts, rarely lets a chance go by of adding another victim to his list should such present itself; whilst that grim gibbet of the woods—the gamekeeper's vermin pole—is usually adorned with one or two owls as feathered trimmings to the motley array of vermin, save in those cases where the keeper is a man of common sense and knows better than to rid himself of his most useful allies.

Not the least interesting of our Owls is the Long-eared species; in some districts, contrary to what is stated by most writers, this bird is even more plentiful than the Barn and Brown or Wood Owls, and a pair may be found in almost every pine wood. But as it is shy and retiring, being also much quieter than the Brown Owl,

YOUNG LONG-EARED OWLS—FROM LIFE.

and by no means so easy to see in the twilight as the Barn Owl, it is often resident in a locality without people being aware of the fact.

In colour it is buff on the upper parts with mottlings of grey and blackish brown and dark brown streaks, warm buff and grey beneath streaked with dark and small transverse bars; the beak is nearly black, and the eyes deep orange-yellow.

Sometimes when passing through a fir wood a sound almost like the barking of a distant dog falls on the ears; this proceeds from one of these birds, and if one looks up very probably it will be seen perched bolt upright on some high branch, staring down and every now and then making its peculiar note. The tufts of long feathers on either side of the head give it a very cat-like appearance, so one might say another of its notes—a kind of mewing—is not inappropriate.

This bird does not build a nest, but takes over the deserted one of a carrion crow or magpie; sometimes the drey of a squirrel is used. The eggs, which are white like those of other Owls, are four or five in number, and may be laid as early as March, but more frequently in April and May.

The young of this species are delightful little creatures to look at, but one should be chary of handling them. The specimens shown here made their claws felt through thick gloves when being taken from the nest to be photographed.

Whilst the most useful of the three is the Barn Owl, which feeds exclusively on vermin and insects, the Long-eared Owl is also beneficial and deserves protection, for its diet is largely made up of voles and field-mice; it also takes young birds, such as those of the finch tribe, on some occasions, but I have never known it guilty of killing game chicks—a crime which is sometimes laid to its charge and the Brown Owl's also.

DARBY AND JOAN.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—IV

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE LAURELS

THERE is only one true Laurel, and that is the Bay Laurel. There are, however, several shrubs popularly associated in one way or another under this name—plants not in any way akin, belonging, indeed, to various families and orders. They are plants with laurel-like leaves, and that is all. All are evergreen. As is usual among evergreens, their leaves are thick in substance, leathery in texture, with often a polished surface. These obvious characteristics have been sufficient to bring about a rough-and-ready grouping under the common name. Unfortunately so, since it has become the occasion of quite unnecessary perplexity in distinguishing one "Laurel" from another.

So we have the Cherry Laurel, usually regarded as the Common Laurel, and the Portugal Laurel, both of which belong to the Cherry and Plum group; the Aucuba Laurel, from its mottled colour and markings referred to as the Variegated Laurel, which is of the Cornel family and so allied to the Dogwood; the Spurge Laurel of the Daphne family, closely related to the Mezereon of our gardens; and the Laurustinus, which were more aptly named Viburnum tinus, since it is of the same family as the Guelder Rose and the Wayfaring tree. Thus not one of these is a Laurel. The only Laurel is the Bay. With so determined and persistent a grouping of these plants under the common designation of "Laurel," it is surprising that some

SPURGE LAUREL.

others have not also been included, as the Magnolia, the Rhododendron and the Arbutus (Strawberry tree), since their leaves are just as distinctly laurel-like as are the others. The typical shape of the Laurel leaf is that of a more or less broad lance-head, tapering to a point at each extremity.

None of these plants, with the exception of the Spurge Laurel, can be regarded as native with us. That flourishes abundantly in many of our woods. The others are cultivated in gardens, and only rarely are they to be met with in a semi-wild state.

THE BAY LAUREL

This is the poet's Laurel. Since the time of the ancient Greeks this shrub, or small tree, has been held in veneration. Its berried twigs, twisted into a wreath or crown, were used to adorn the victors in the Pythean games; so the Laurel crown came to be regarded as the distinctive reward of valour or of scholarship.

With us the Bay is usually a rounded shrub only. It flourishes fairly well in sheltered places in the southern counties, but it can only just withstand our ordinary winters. The last winter, with its exceptionally low temperatures in these counties, cut down many a cherished Bay tree.

The leaves of the Bay are alternately arranged on the shoots. Their margins are without teeth. The most noteworthy characteristic of them is their fragrance.

BAY LAUREL.

From this the shrub derives its by-name of Bay-sweet. Pollen-bearing flowers are distinct from fruit-producing flowers, and they grow on different shrubs. They are to be found in small clusters at the junction of stem and leaf-stalk. Each has four small petals, which are creamy white. The small oval berries ripen to a dark purple. They will, of course, only be found upon those plants that have borne fruit-producing flowers.

THE CHERRY LAUREL

This has come to be with most people the Laurel, though, as before stated, it is not a Laurel at all, but an evergreen member of the Cherry and Plum group. It is cultivated everywhere either as bush or hedge. Hardier than the Bay, it is not so hardy as its Portugal cousin. It seems to be peculiarly sensitive to impurity in the atmosphere, and becomes the forlornest of shrubs under the influence of the smoke of the town.

The twigs and buds are green. The leaves, which are arranged alternately, are of a bright yellowish green, polished and shining above, paler and matt beneath. The margins show small, irregular teeth. The leaf-stalks are short and stout. As with the Cherry, its near of kin, there are honey glands, but these are on the under side of the leaf-blade on either side of the base of the midrib, not on the leaf-stalks. They take the form of slight depressions, minute, green at first, changing to purple as the leaf matures, scarcely discernible in winter. The leaves, when bruised, emit a distinctive scent, as of bitter almonds, fatal to insect life in any enclosed space.

The flowers are grouped in erect, rather slender spikes, rising from the stem at the points of junction with the stalks of the preceding year's leaves. These spikes, like those of the Bird Cherry, comprise a central stem with radiating short branches, to each of which a single flower is attached. Each flower is complete with stamens and pistil, has small white petals, and is freely visited by insects for pollen and honey. The fruits, in branched clusters, are nearly as large as cherries, but less rounded, are black when ripe, and, like the cherries, have no waxy bloom.

PORTUGAL LAUREL.

THE PORTUGAL LAUREL

This rounded shrub, or small tree, is so closely allied to the last that it may be regarded almost as a variety. It may be distinguished readily.

FLOWERS OF PORTUGAL LAUREL.

The twigs and buds are a purplish red. The leaves are darker in colour, lacking the yellowish tint; they are thinner in substance, and harder in texture; also smaller, and, less space of stem intervening, they appear more crowded. Their habit is decidedly pendent. The margins are "filled-out" and regularly serrated. There are no honey glands either on stalks or leaf-blades, and there is no smell of bitter almonds when crushed. The flower spikes are less slender, and the individual flowers more conspicuously white. The smaller fruits are longer in proportion to their breadth.

THE AUCUBA, OR VARIEGATED LAUREL

Though no relative of either of the preceding, this shrub, in habit and appearance, is remarkably like the Cherry Laurel. Its leaves, when not variegated, show the closest resemblance, in size, substance, colour, and surface. There are but few, wide apart teeth in the margins, scarcely noticeable when young, but frequently developing into broad indentations later. Conclusive points of distinction are found in the facts that the leaves are arranged in opposite pairs on the shoots, they have no glandular depressions on the under surface, and they emit no smell as of bitter almonds when crushed. They are, however, usually variegated, being grown chiefly for that reason. This variegation consists in white or yellow markings or blotches, irregular as to size and position, appearing as if the green colour in the substance of the leaf had been here and there chemically dispersed.

Pollen-bearing and fruit-producing flowers are distinct, and they appear on different plants. These flowers are not gathered into simple spikes as those of the Cherry and Portugal Laurels, but into loose, many-branched clusters, each branch bearing a terminal flower with others to right and left immediately beneath. Each flower has four

FLOWERS OF BAY.

small petals, claret-coloured or green, and inconspicuous. Flies visit the flowers for pollen. The rounded fruit is bright scarlet, roughened at the top where the style has withered, giving some resemblance to a large haw.

2 3 4

LAUREL LEAVES.
1. Portugal Laurel. 2. Cherry Laurel. 3. Bay. 4. Aucuba.

THE SPURGE LAUREL

This woodland plant is but a diminutive shrub growing only to a height of two feet or so. Its long, supple stems rise direct from the root, and carry their foliage chiefly at the top in the form of tufted rosettes. The stems are grey or whitish, coated with hairs. The leaves, whose margins are without teeth, are dark green and polished above, lighter and matt beneath. They are practically stalkless.

The flowers, which are complete with stamens and pistil, are tubular, having four divisions at the top after the manner of petals. They grow in small clusters at the junction of stem and leaf, are green, inconspicuous, and without scent. Yet they are freely visited for their nectar by bees and other insects, opening in March, as they do, when supplies are scant. It should, however, be borne in mind that attached to the flowers are modified leaves (bracts), and these serve to render their clusters more conspicuous. The small oval fruits are bluish-black. They are said to be poisonous to all creatures except birds.

THE LAURUSTINUS

This garden shrub, an evergreen *Viburnum* from Southern Europe, is only included here because of the implied association of its name. Its leaves are like those of the Bay. In distinction it may be noted that they are rather less pointed at the base, are without the characteristic fragrance of the Bay leaves, and are arranged in opposite pairs on the shoots. Its flowers are in close agreement with those of the allied Wayfaring Tree. They are complete with stamens and pistil, are tubular with five expansions at the top simulating petals, and are carried so as to form flattened clusters. In the southern counties they expand in late autumn, but farther north this is deferred till the following spring.

HENRY IRVING.

TABLE SHOWING POINTS OF DISTINCTION IN LAUREL LEAVES

	Arrangement.	Margins.	Special Characteristics.
Bay	Alternate . .	Without teeth . .	Fragrant
Cherry Laurel . .	Alternate . .	Small irregular teeth .	Minute glands near base of under surface: scent of bitter almonds when crushed
Portugal Laurel .	Alternate . .	Full and wavy; with regular teeth.	More crowded, pendent, scentless
Aucuba . . .	In opposite pairs	Few wide apart teeth, chiefly towards the apex.	Usually variegated, scentless

COMMON GARDEN SNAIL (*HELIX ASPERSA*).

BRITISH SLUGS—I

By MAUD U. CLARKE

With Photographs by the Author

THE Slug family are a branch of the terrestrial *Mollusca*, in itself a division of invertebrate animals possessing soft bodies and an elaborated organisation that places them in a higher position than the insects, and only lower to that of the fish tribe.

In due form we have to recognise the Slugs as of the class *Cephala*, sub-class *Gastropoda*, of the order *Inoperculata* and sub-order *Pulmonata*. All four names are valuable as condensed explanations. The term *Cephala* implies a distinction between molluscs possessing definite heads that crawl on land, and the *Acephala*, or aquatic molluscs, that float on water and breathe through gills like fish. *Gastropoda* implies that the animal is a univalve mollusc, the shell being of one undivided form and having the lower surface of the body constructed as a foot-sole.

Inoperculata implies having no horny or shelly plate, called the *operculum*, with which many molluscs close the orifice of the shell for protection against enemies or for warmth during cold seasons.

The Snail has no true *operculum*, although it coats over the orifice with a secretion that hardens like a plate during the winter hibernation.

Pulmonata has reference to the animal being possessed of lungs.

The *Cephalic* molluscs have a distinct head and generally tentacles, or "horns," with so-called "eyes" at the tips or base. The "foot," or muscular disc, is capable of either crawling on the earth or floating on the water, the aquatic tribe forming a large separate order. When dealing with the question of the shell, we recognise a main division into two groups, those of the *Univalve* and *Bivalve*. The spiral shell of the Snail is familiar to every one as a representative of the *Univalve*, although perhaps the fact that the Slug family in several instances are also possessed of univalve shells may not be so generally known.

Throughout the great chain of differentiated species in the Nature world, we always find links, or connecting points, that show us the meaning of differences between specially developed families. Here and there, indeed, these links are

found to be missing, yet the negative truth is almost of as much value evidentially as the positive demonstration. Very frequently, however, these links are not demonstrated by the completed animal form, but are to be traced in the embryonic stage.

The tribe of the Sea Slugs, or *Nudibranchs*, in the embryonic stage are provided with a unispiral shell, whilst the *Limacidæ*, or Land Slugs, possess a shelly plate which is embedded in that part of the animal termed the "shield," or "mantle."

The position of the "shield" is either close behind the head, spreading backward over the body in oval shape, sug gestive of a mantle over the shoulders, or at the rear of the animal, as is the case in the genus *Testacella*, or Snail Slugs.

This apparent variation in the position of the "shield" is, however, due to an abnormal development of the neck of the Slug in advance of the "shield." The *Testacella* hold an intermediate position between the *Helix* or Snail family that live in shells, showing them externally, and the Slug family, that only possess interior shells. The shell of the *Testacella* tribe is a truly formed one, often exceedingly beautiful and delicate in construction, and is shown externally, although the size in respect of the animal is certainly disproportionate. There is, however, no pretence of it being a "house of refuge" as with the Snail; it appears to be merely a protective plate that is always associated with the "shield" that overlies the vital organs of the animal, such as the pulmonary chamber, heart, etc. The noticeable respiratory orifice seen as a round hole on the border of the "shield" on the right side of the animal lies beneath the shell of the *Testacellidæ*.

The tribe of Snail Slugs, carrying their shells externally to the rear, are subdivided into three fixed species: (1) *Testacella haliotidea*, (2) *T. scutulum*, (3) *T. maugei*.

The first-named is a pale yellow slug about three inches long, found throughout England in established localities. The "shield" is nearly hidden by the ear-shaped shell, which is flattened rather than convex in form. The illustration* shows the shell apart from the dried animal, that is, of course, shrunk in bulk; but the photograph gives practically the natural size of both shell and slug, although not in the extended form.

T. scutulum is a darker-coloured slug, yellow or brown, of the same length, and somewhat similar shell. *T. maugei* is larger, about four inches long, of a dark-brown colour, with a much larger shell, more cylindric in shape.

This family, as many others of the Slugs, only go out after food at night, remaining below the earth surface during the day. They are carnivorous feeders, and attack conveniently sized earthworms.

Having marked their worm as satisfactory when encountered on the nightly prowl, the slug draws in the tentacles and dilates the mouth, pounces suddenly on the worm and proceeds to draw it in. This is a very leisurely performance, and on such occasions the expansive capacity of an invertebrate comes into full play of possibility. It is stated that an average life for these slugs is as long as five or six years.

In respect of the Land Molluscs generally, it has been noted that variations of colouring are more marked in the southern and western counties, when the type itself becomes rare. Mild climates produce stronger-coloured forms; colder climates the dull-coloured typical forms. Variations appear to be also produced by the geological conditions of the habitat and by differences of food.

The eggs of the *Testacella* are deposited at considerable depth in the ground, in galleries bored by the animals; they are coated with a calcareous shell that bursts when brought into contact with warmth. The young slugs hatch after ten to thirty-five days, according to the species, and are full grown in eighteen months, living five to six years. The south-west counties of England seem to be the favourite localities for this slug.

The two large classes of the *Limacidæ* and *Arionidæ* are each subdivided into what may be termed typically specialised Slugs.

In respect of shell formation, the *Limacidæ* come nearest to the *Testacellidæ* as possessing definitely formed shells,

* Photos taken from Natural History Department, British Museum, Cromwell Road, South Kensington.

although hidden beneath the skin. The shell lies beneath the "shield" of the slug, is oval or oblong in shape, white, and slightly concave. The concentric lines of growth demonstrate that the external shell, of which it is assumed this is the relic, was one spirally coiled. The *Limacidæ* is one of the groups which retain in the full-grown animal the primitive shell formed by the shell-gland of the embryo. It is said to be the shell held by the Romans to act as a charm against accident or disease, called the *Lapis limacrum*.

On the "shield" of these slugs the skin is marked by fine concentric lines, a distinctive character that parts them from the *Arionidæ* family.

A second distinction lies in the relative position of the respiratory orifice, or breathing hole, on the border of the "shield," which is placed behind its centre, whereas the *Arionidæ* have the orifice in advance of the centre, nearer to the head.

The third distinction lies in the perfectly formed shell. The class is divided into three groups: (1) *Limax*, (2) *Agriolimax*, (3) *Milax*, the two latter species varying from the first-named in certain important characteristics.

The *Limax* is a highly organised tribe having such great power of adaptability when transferred to other countries that the aboriginal species becomes few and the *Limax* increases its range of habitat. Their existence is recorded in very old fossil deposits, that of the German Lower Miocene, which is a fairly old family history for any animal to boast of.

Speaking from personal acquaintance of the *Limax* in captivity, as compared with the *Arion*, I call him by far the more interesting animal of the two. There is an alert rapidity of movement, a determination to remove himself promptly from trying circumstances that one can but respect.

If slugs can be said to be "keen," he is a keen slug; he is quick to discover change of diet, and never loses time in discovering that cooked potato or carrot has been placed among the cabbage or lettuce leaves provided. The olfactory sense appears to be sensitive. When handled for portrait-taking they quickly recover the sense of rebuff, and when moved into required position for focus from their own track of escape, pertinaciously set off again with a strength and determination one hardly credits the tribe with possessing.

SHELLS OF (1) *LIMAX MAXIMUS*, LINNE; (2) *AGRIOLIMAX* OR *L. AGRESTIS*, LINNE (Essex).

SHELLS OF (1) *TESTACELLA HALIOTIDEA*, DRAPARNAUD (Surrey); (2) *T. SCUTULUM*, SOWERBY (Surrey); (3) *T. MAUGEI*, FERRUSAC (Kensington).

The food and habits of the *Limacidæ* are exceedingly variable. Some are nearly subterranean in existence, only leaving their burrows in wet weather or at night. Some are practically omnivorous, whilst others are purely fungus feeders, all, however, having a lurking tendency towards cannibalism. In some species there is the predatory instinct displayed. In their turn they are preyed upon

LIMAX MAXIMUS (*VAR. TETRAZONA*), A SLUG HAVING TWO BANDS ON BODY.

by many birds, frogs, and toads, and by the blind-worm. The wood ant deals with the eggs to their diminishment, as do several of the flies.

Limax maximus forms a group showing a range of ten varieties, besides a list of sub-varieties that have been classified, with an admitted capacity for further extension. Beside the variation of colour, ranging through black, white, grey, brown, ochre-red, and a curious pale crimson (*L. maximus vinosa*), there is an elaboration of the markings on the "shield" and the longitudinal stripes on the body.

L. maximus sylvatica, a cold grey colour, shows two continuous bands of darker sepia-grey, strengthened with irregularly formed black markings, with a third band of broken markings approaching the "foot-fringe" or border of the "foot-sole." The "shield" shows light mottlings outlined sharply with black; the "foot-sole" a light yellowish-white. This is regarded as the typical form. The rugosities, or elevations of the skin folds, are fine and closely set together. The animal has no slime-gland, the mucus being produced from the pores of the skin. The "shield" is a broad oval extending backwards from the neck of the slug, always marbled or spotted. The dorsal "keel," or ridge, only extends upon the caudal extremity, or lateral inch of the total length of the animal, and is lighter in colour. *L. max. fasciata* has three longitudinal bands; the varieties *L. max. tetrazona* and *L. max. obscura* possess but two bands; in the latter they are rather blurred by a superficial pigmentation of the skin overlying the pigmented cells forming the bands. The theory of these and other markings is that the action of atmospheric conditions upon the areas of the animal's body, associated with main blood sinuses, produces an accumulation of the pigment.

The primitive stage is that of uniform colour—yellowish, greyish, or reddish; the second stage that of bands and markings of distinct character; the third stage, when overlying pigmentation of the skin diffuses the markings, or entirely obscures them.

In this country the ground colour of *L. maximus* is usually ash-grey, or the occasional brighter shades, as in variety *L. max. tigris*, which has only two bands, the upper, or inner, one the broader.

The hidden shell lies beneath the curved outline of the slug, over-arching the respiratory orifice. The colouring of the "foot-sole" of the species is light yellowish white, the average length from four to six inches.

In *L. max. cellaria* the longitudinal bands are broken into oblong, rounded patches, black on a pinkish-grey ground colour. As the name suggests, it is a frequenter of cellars, gardens, outhouses, etc., and not found in open country. This is a characteristic of the *Limax* tribe in general.

Limax flavus is a very handsome slug of golden-yellow colour, tinging to olive; the colour, being due greatly to the slime excretion and condition of the animal, varies in brilliancy of the yellow. When in captivity the colour becomes darker and more of the olive tint. The "shield" has a mottled appearance, varying the two colours; the "fringe," or muscular border adjoining the "foot-sole" of the animal, shows the brightest colour, whilst the "foot-sole" itself is nearly white.

The plantar surface is marked with transverse bars, which when seen in motion through glass show a most wonderfully fluent action, as continuous as the rippling of water in a breeze. In beautiful contrast with the body colour, the tentacles are transparent blue.

The eggs are deposited in moist crannies under logs, etc., between July and as late as December, in batches of half-a-dozen to twenty, hatching after forty to sixty days, the animal becoming fully grown in a year.

L. flavus is a voracious feeder, eating bread, cooked meat, and butter equally with mildew of walls or fungus of other kinds. Lettuce and cabbage are eaten in captivity, although fungi and lichen are preferred to green vegetation.

Limax cinereo niger is a class that contains the largest and most brilliantly coloured varieties of any group as represented by the Italian and other European forms. In the British Isles, however, the cool climate produces only the type form—black, and uniform dark colourings.

The type form shows the body a dark slaty black, with the clearly distinguished white dorsal line and central part of the "foot-sole," the outer borders of which are of similar dark colour as the body. The "keel," extending about half the length of the body, and sometimes the whole, is much accentuated towards the tail, showing a distinct series of elevations; the rugosities of the skin are as coarse as those of the *Arionidæ*. The "shield" is one colour, and never mottled as *L. maximus* and *L. flavus*, measuring two-fifths the entire length of the slug. Of the five sub-varieties *L. cinereo niger lactuosa* has been recorded in Yorkshire, Warwickshire, Staffordshire, Cheshire, and Glamorganshire. This variety shows a yellowish-white "keel" and dorsal line that only extends half the length of the body. The species is a fungi feeder, less nocturnal, and more active than *L. maximus*, an inhabitant of pine woods, hiding in the bark of the trees. In Italy the red, yellow, or parti-coloured varieties inhabit the plain, the darker coloured animals the colder mountainous districts.

The Tree Slugs, *L. arborum*, are another distinct group, slender in form and often of beautiful colouring and marking.

LIMAX FLAVUS (VAR. LIVIDA).

MORE ABOUT SEA "FIRS"

By S. F. MAURICE DAUNCEY

With Photographs by the Author and others

AS was stated in a former article, the Sea "Firs" washed up on the beach are generally only the skeletons of colonies which have now done with the rough and tumble life of their ocean-

Photograph by A. F. Dauncey.

1. SICKLE CORALLINE.

world. Sometimes, however, colonies may be found there which are still alive, and occasionally such can be picked up even at the fishmonger's attached to shells.

But if you wish to study these interesting forms of lowly life with anything like care, you should not depend on specimens picked up thus by chance, but get live colonies from those natural aquaria—the rock-pools. Quite a number of Sea "Firs" can be found in these.

As soon, however, as you take out of the pool the shell, or bit of rock, or blade of weed on which the colony has settled, you are likely to be disappointed. Its lovely feather-like form has gone as though an evil magician had, unseen, waved his wand above it. But "the grace of the fashion of it" was not an illusion. It was due to the "pinnæ"—the feather-like growths from the branches of the main stem—standing out each distinct from its neighbour. But when the colony is withdrawn from the water they collapse into a formless mass. This is the case with the "Fir" known as the Sickle Coralline (*Hydrallmania falcata*), two photographs of which are reproduced. The first shows an aquarium specimen in which the natural

2. SICKLE CORALLINE (DRIED).

Micro-photograph by Frank Slade.

3. *PLUMULARIA PINNATA.*

MAGNIFIED PORTION OF SEA "FIR."

form is preserved; the second shows a dried colony in which the sickle shape assumed by the branches *when dry* can be seen. These colonies sometimes grow to about a foot in length, and are often mistaken for seaweeds.

On placing a colony, taken from the rock-pool, in your collecting jar filled with sea water, the little zooids will soon come out of their hiding-places in the horny zooid-cups; and you will be able, with the aid of your pocket lens, to make out certain facts about them, *e.g.* as to how they feed, and as to how they save themselves from being fed on.

For as you look you will learn that they are doubly equipped; they have arms of attack—their many tentacles; and, better off than yourself, their "skeleton" is their castle.

With their tentacles, fine as they are, they catch their prey, and the stinging cells with which they are provided paralyse their unhappy victims. The same thing happens with the fresh-water Hydra *Viridis*, which "plays" its capture like some skilful angler; but, even should the prey be immediately released, it invariably dies from the stings inflicted. In the illustration on this page these tentacles are shown in a greatly magnified colony of *Plumularia pinnata.*

4. *ANTENNULARIA ANTENNIA.*

The "skeleton," as it is called, of the whole colony consists of the same horny protective matter as the individual zooid-cups. The "feeding tube," to which reference is made below, is surrounded by it. For life is a struggle and a conflict even in these lowest grades; and while hungry enemies are out on the search for food, our tiny zooids would be snapped up as unconsidered trifles, were it not for the

enveloping sheath and the cups which give them protection. But even so, the Sea Slugs, with their lack of nice dis-

Photograph by A. F. Dauncey.

5. *ANTENNULARIA ANTENNIA.*

crimination, annex them—horny skeleton and all.

But our zooids are socialists, nor do they stay to distinguish between "mine" and "thine." The stem from which the branches grow, with their groups of pinnæ, is hollow, and so is the base of each cup. And through these channels the food caught and prepared by any individual zooid is distributed to the whole colony. And this is not more generous than necessary. So low down in the scale of communal life we find specialisation of function, and that there are some members which are incapable of obtaining food for themselves. But they must be fed—for, like that of the queen bee, their duty is the highest—to produce the eggs from which fresh colonies will be formed. One of these reproductive members, lettered A, is shown in the accompanying drawing (see page 1071) of a considerably magnified portion of the colony represented on page 776.

The eggs are carried away by the tides and soon hatch out into little larvæ. These are at first covered with minute hairs, or cilia, by rapidly vibrating which the larvæ swim and reach a favourable spot for settling down. When they have done this they lose their cilia and form the beginning of a fresh colony.

Two specimens of *Antennularia antennia*, in some places popularly called Lobster's Horn Coralline, are shown in illustrations 4 and 5. The first shows a dried colony as generally found on the beach, with all the pinnæ rubbed off. In the second the colony was in an aquarium when photographed. Illustration No. 6 is of a Sea Oak Coralline (*Sertularia pumila*), a kind often to be picked up between the tide marks on the blades of large weeds, and specially interesting because of the phos-

6. SEA OAK CORALLINE.

phorescence of the edges of the zooid-cups. You need only wait till the evening, and then rap sharply the spray of seaweed on which your colony is growing, and you will have an evanescent fairy scene—the shining of a series of very tiny glow-lamps.

S. F. Maurice Dauncey.

MOONRISE ON THE HARBOUR BAR.

From the Oil Painting by Algernon Talmage, R.B.A.

THE PERGOLA WITH RAMBLERS. *Photograph by R. A. Staig.*

HAPPY HOURS OF SUMMER

By R. A. STAIG

DAY awaking, slowly fades the sleepy haze of morning grey. Eastward a growing brightness and streaks of ruby in the clearing sky herald the rising sun. As the light spreads radiance around a rosy glow heightens on the face of peaceful morn. The breaking clouds are flushed with crimson. Again a cock crows and a neighbour answers him. Passing so lightly, the crisp morning breeze brings a faint rustle among the grasses. Care goes at its touch. Promise-laden, it whispers hope to the heart, a bracing message of fresh purpose, of the joys of living, of the goodness of the earth.

Starlings are already on the lawn. A speckled thrush has joined them, running forward to stop abruptly as if to listen; one swift wriggling peck, and the worm outwitted is taken like a flash. A blackbird slips up into the bushes uttering his rattling call-notes. Jenny wren is awake in the coppice, finches flit to and fro, and the chirruping of sparrows has begun.

Crystalline the ever brightening glare streams upward, illuming wide the heavens. Beyond the verdant hills, their

misty veils withdrawn, the sky is brilliant gold, and saffron tints suffuse the firmament above. Then comes the moment when, behind the gold-crowned ridge, the dazzling ray shoots up, close followed by the burnished sun.

In the dew-pearled pastures quietly the cattle have risen, contentedly they feed. With what a generous hand hath Nature jewelled the common grass, each moist, green blade bright-set with liquid glistening gems—soul sweetness from the ground effused to permeate the summer air with pure, refreshing fragrance! The timid rabbits frisk and scamper o'er the glittering lea. One moment a lapwing sweeps so near, you start at the strong swish, swish of wings; and the next it is high and away a field's length, doubling back "*pee*-weep, *pee*-weet." Far in the deepening blue a lark sings the matin of praise:

"Sweet is the breath of morn, her rising sweet,
With charm of earliest birds."

In and out among the hills, along a hollow, winds the stream. From the hot and dusty highway its tortuous course, like a broken thread of sparkling silver, issuing from the moor, is lost to view the while it tumbles splashing, frothing through the rocky glen; then, seen again, is rippling in the woods and gliding o'er the meadows. It draws like a magnet. Ever there so much for eye and mind to dwell upon; never is the summer day long enough by the stream.

Going one way the road leads between pasture slopes with yellow ragwort, sturdy Scotch thistles, and the lowly field madder

Photograph by R. A. Staig

"AMONG THE MARSH PLUME THISTLES."

Photograph by T. H. Yeldham, Wallington.

TOWERING FIRS AND THE HEATHERY HILLS BEYOND.

Photograph by T. H. Yeldham, Wallington.

"A CLEFT OF VERDANT LOVELINESS, WHERE WAVY GRASS AND FERNS IN WILD PROFUSION O'ERHANG THE SILVERY WATER."

hidden among the wiry grass. Under the fervent dancing glare of the sun the whole field vibrates with life. The very atoms of the heated air resound. First one, then another, then many together, the grasshoppers shrill. At every step, up they spring and away—long, curved, flying leaps over the grass. Colour engrailed and spotted, quaint little hoppers scatter like sand before the foot; yellow-striped and coppery-gleaming flies moving on the flowers, and the tense buzzing of flies swiftly passing hither and thither and hovering in the air. Lavish spreads of purple thyme where the field dips down to the road, and the humming bees pollen gathering, intent, not a floret unexplored. Flower of the fullness and prime of summer, like the bees so reluctant to leave it, the spirit is enriched in contact with it. Its rare perfume is a power of good. Crossing the road, two white butterflies sport together, now rising, now falling, chasing each other round and round in giddy circles. Sudden, swift, and high slants the one out of sight; leisurely the other, fluttering to a purple knap-weed, shuts its wings, wheels half a turn, and motionless rests.

Now grown so tall and overhung with tresses rich of creamy crimsoned honeysuckle, the hedgerow forms a sheltering screen in the scorching hour. Freshness and beauty are of its leafiness, a wealth of variant green, of hawthorn interwoven with barberry and glossy undergold of beech and hazel. There white and pink the sweet wild rose; impulsively the hand goes out to clasp its sprays of floral loveliness. Hedge-sparrows pass in and out, wrens rustle among the leaves, greenfinches "twee, twee," and the yellowhammers are singing. Under the hedge and rearing high against it waves of grasses, club-tipped and panicled, foxtails, cocksfoot, silvered pink soft grass, brome dusty with pollen which falls in showers at the touch; and among the grasses bittersweet and the trailing St. John's wort entangled with cleavers, and long strings of blue vetch intertwining up the hedge. Tall in the ditch stands the

Queen of the Meadow crowned with corymbs of perfumed cream. Silverweed, shepherd's purse, rib-leaved plantain, and dandelions star every inch of available space along the dusty verge of the track. All is an undulating bank of verdure and flowers. Peerless blue of speedwell and the yellowed green of bedstraw commingling with the honey-scented crosswort; unbroken breadths of brilliant yellow lotus; touches of pink throughout—lychnis pink, and the bluish pink of crane's-bill.

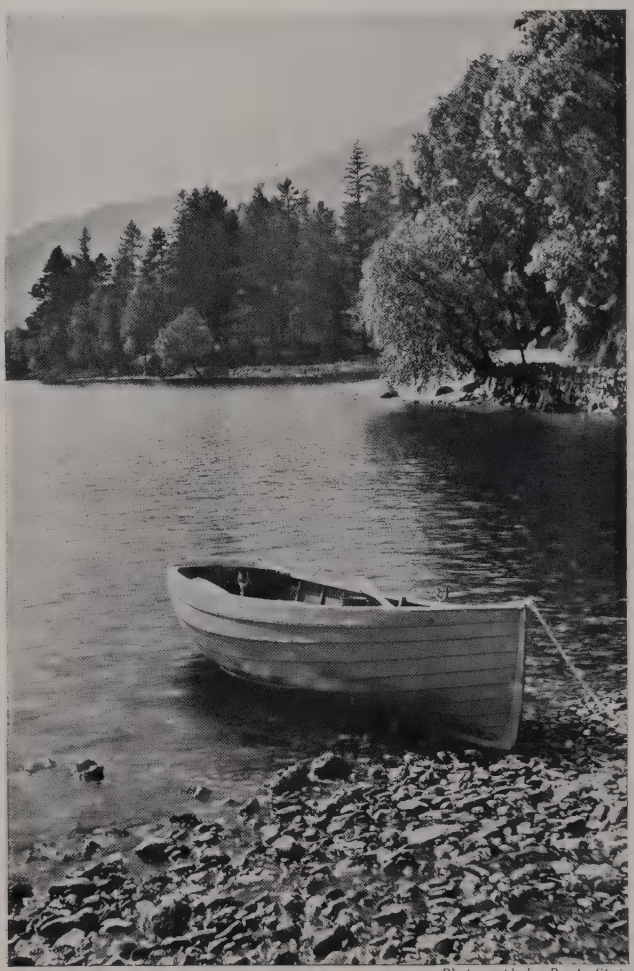
The rose spray we plucked has its coterie of green aphides gathered around the stem, and beetles so tiny haunt its opening buds; on one green leaf a red spotted ladybird creeps, from another falls a caterpillar, and the one with the curled edge has a restive grub within. Every sprig of hawthorn has its golden weevils; and the forest of grass blades is a world of hidden creatures. Everywhere increasing crowds, but always space; flowers massed close together, more flowers pushing through their midst. Yet all this crowded luxuriance conveys no feeling of restriction and confinement, but rather of expansiveness and liberty, and it is impressive of an inexhaustible richness. Viewing it all, seeing the lightsomeness there, the heart is filled with a happy sense of the fullness and freedom of life—a healthy optimism begotten of the hedgerow in the sunny hour.

The open road has its charms, but the less trodden bypath is a stronger attraction—dustless, sequestered, more varied, more in the heart of things. By whichever way it takes you, there you walk in closer communion with Nature. Each prickly bramble arch or wisp of wayward grass ensnaring to the foot is a beautiful conspiracy against haste. It is the touch of Nature staying the step that you may see her beauties, know her better, read her wisdom, love her more.

Soft and springy, full of the sap of life, rushes surround the path through the marsh, a wilderness of deep green, spotted

Photograph by T. H. Yeldham, Wallington.

"GRASSY AND SOFT, THE PATH WINDS THROUGH THE GLADE AMID THE BRACKENS."



Photograph by R. A. Stacy.

"THE GLEAMING WAVELETS LAP THE STONY STRAND."

with buttercup gold and sprinkled with the pink of ragged robin. Tall beyond the knees, bending with height, and so thick together, the green rushes hide the spongy Sphagnum moss about their roots. Coloured like the moss, little frogs hop and leap among it, unnoticed ere they jump. White galium and blue forget-me-nots intermingle with the rushes, and here are orchids light purple lined and blotched, and the yellow racemes of bog asphodel; here, too, though sparingly, the Grass of Parnassus. How beautiful its floral cup indented, white, and delicately veined with green! But look within the flower, and see the nectaries around the centre, like tiny fans outspread and fringed with beads of amber yellow. Numerous as the rushes, stilt-legged crane-flies rise with an audible whir of wings—a short flight, like the slow brown butterflies which flutter an instant, then disappear. Now and then a pretty silvered blue flits swiftly by. Among the marsh plume thistles there is an endless procession in progress, a pageant of insect life. One moment it is the metallic splendour of a "greenbottle," and the next perhaps a striped hover-fly poised above a bloom, its wings spinning a halo; or some bee you do not know, or a weevil you have never seen, each with its own strange history, each with something for the loving eye.

Sweet on the ear falls the murmur of the rippling stream. There is joy in the sound of the crystal flow as it hurries onward over the stony shallows, bubbling and sparkling in the sunshine. Memory treasures its song; through the grey hour it sings again in the mind, calling forth so vividly all the happy recollections of the summer day. So clear the water you see the trout and parr dart off like shadows. A wagtail flies out from under the bank, an undulating flight across the ripples. You cannot see the nest hidden under the earthy ledge, but lying down and stretching the arm underneath at length you touch something soft and warm, a little family of four, late-comers. With the big cocksfoot grasses, pink yarrow and purple self-heal colour the bank. Sweet cicely and yellow mimulus flower along the water's edge beside the iris flags and branching burr reeds; white ranunculus o'erspreads the quieter reaches. Midstream a heron rises from his fishing, flapping heavily upwards to the tops of the tall trees opposite. With difficulty he alights, the pliant bough swaying under

him. Myriads of midges make the alder shade impossible—minute specks with speckly wings settling continually on the face and hands, swarms of the biting Ceratopogon. The larger forms are scarcely worse—gliding along the banks the swallows devour them in thousands, yet day after day they are as numerous as ever.

Away goes a brown dipper, straight up stream, skimming along the surface to a rock. A dozen times he bobs up and down as if curtseying. Wading into the water, buffeting the current with his broad white breast, one minute he is under, then up again, wading on, dipping his head quickly from side to side.

Nearing the woods the stream narrows, flowing between steep banks; a cleft of verdant loveliness, of matted woodbine and trailing bramble, where wavy grass and ferns in wild profusion o'erhang the silvery water falling in tiny cascades from pool to pool among the rocks. Grassy and soft, the path winds through the glade amid the brackens. Rare beauty is here; green of oak and spruce, darker hues of firs, and the green of grasses and branching bracken tall around the trunks, a blended tracery of variant foliage brilliant under the ethereal blue. Green mosses carpeting the pathway heighten the colouring and accentuate the coolness. "Coo-coo, roo-coo," the ring dove crooning; tits "chee, zee," sounds in the reigning stillness. "Koor-lee," high above the towering firs a curlew winging its way to the lone moor. Again the weird "koor-lee."

Beyond the pines the hills are tinged heath purple. You cannot see it, but it is there, yellow tormentil, summery dots amid the ling; and fancy hears again the old familiar cry, "errrr, beck, beck; goback, goback, goback," a grouse alighting on a heathery "knowe."

Wasps are everywhere. Not until the season's prime do the wasps appear. They come, as it were, to enjoy the cream of summer. There is a continuous file of wasps to and from a printed bill upon the telegraph pole. Bit by bit they are cutting it away, carrying it off to make a flaky papier-maché for the nest.

Livid scarlet poppies glow among the ripening corn along the margin of the fields. Scentless, bitter, and poisonous, there is a subtlety about the colour of the poppy which saves it. Common, but never commonplace, are the poppies. Great spreads of yellow as far as the eye can reach, the chervil or wild mustard scattered throughout the oats; and acres of potato blossom, some white, some light purple. How sweet the scent of the new mown hay from the fields where the workers toil in the sweltering heat! Bees are busy there on the purple heads of the uncut clover. Gad-flies torment the horses, gathering in swarms at every swish through the grass. Were it not for the troublesome flies, how pleasant the haying!

Lightly across the loch the cooling breeze fans the hot air. The gleaming wavelets lap the stony strand. The whole expanse bespeaks repose. The pine-clad slopes invite, red deer are yonder, but the heat is overpowering; it is enough to look there, then seek some shady nook beside the flags and gauzy dragon-flies to dream awhile.

Happy together, the sun-browned children gather harebells and "silver shekels" in the meadow. Corncrakes "crex, crex." In the west the sun sinks down; the daisies close, the clover leaves are folded, sleeping. Now is the hush of eve, with noiseless bats abroad and chafers droning past, and flickering brimstone moths. Later the thick-bodied Noctuas tap, tap against the panes. And through the night "tu, hoo; whoo, hoo," the tawny owl.

All too soon the days will pass, the days of butterflies resplendent, of glorious peacocks, admirals red, and painted ladies gay, and with the harvest hues the big drone fly will come upon the sunflowers and thistledown float through the air with summer on the wane. But that is not to-morrow, and even supposing, it will all return again, for in each green leaf, in each coloured petal, in every living thing, there is hope, always hope. Oh, happy, happy summer hours, so sweet and inspiriting!

R. A. Staig.

ARION ATERIMMA (BLACK) PARTLY EXTENDED.

BRITISH SLUGS—II

By MAUD U. CLARKE
With Photographs by the Author

ARIONIDÆ

THIS class of Slugs present very distinct differences of character from the *Limacidæ*, and as represented in the British Isles are subdivided into the two groups of *Arion ater* and *Geomalacus*.

The shell is reduced to some coagulated grains of calcareous pulp lying within the shell-sac beneath the hinder part of the "shield." When exposed to the air the grains harden, the condensation varying to some extent with the age of the animal. The body is rounded and stout, the skin-folds being cut and recut into coarse elevations. The "shield" has an indented or granulated surface quite unlike the ringed lines of *Limax*, and shows the respiratory orifice on the right anterior border of the "shield" nearer to the neck of the animal than the last-named species.

These two points of difference are easily to be decided in looking at the slug, and show to which of the two classes a specimen belongs.

The "foot-sole" is white or light with few exceptions, and shows a distinct pedal groove; the "foot-fringe" is sometimes noticeable as a distinct variation in colour from that of the body, as in the greenish-grey variety that has an orange "foot-fringe." This muscular border is further accentuated with fine black transverse lines.

This slug is nocturnal in habit, hiding from heat during daytime, and only emerging in cool, wet weather.

After days of drought in summer when rain threatens we often see black specimens of *Arion* at full stretch, travelling over the roadside grass after leaving their quarters in the ditches. They are voracious feeders, but their length of life is not estimated as over a year. Compared with *Limax* they are feeble in recuperative vitality, easily succumbing to injuries. A black *Arion* died within a few hours after a fall of eighteen inches upon a deal table, whereas a specimen of *Limax maximus* fell a height of five feet upon a gravel path, and seemed none the worse for it. In temper, I should regard the

Arions as sulky, and distinctly trying as camera subjects. When touched they contract into hemispherical balls, remaining so for a considerable time, keeping up a slow rocking movement like a boat in water at ebb-tide. Some suppose that this action is intended to intimidate the enemy; from the human standpoint it is eminently ridiculous and exasperating when you want to get a picture of *Arion* extended. The slug measures from three to five inches; the colouring is variable, the black and the red the two main types. They can be regarded as primary or climatic distinctions of colour—the black with cold and wet localities; the red with warm and dry ones. It has been noted that the pigment cells in the skin of red varieties are affected by a wet season, when the number of black slugs is increased. The American types show links with this group which relate our *Arions* with a tribe not originally shell-less, but possessed of spirally formed shells.

In addition to fifteen varieties of clearly differing colour scheme, there are other accepted sub-varieties. *Arion ater*, black, have a sub-variety *A. aterimma*, black, with the "foot-sole" dark also, a more uncommon slug. The specimen for illustration was one of these, the "foot-sole" being a dark slaty blue, from York district. *Castanea*, dark brown, with burnt sienna "foot-fringe"; *Plumbea*, purplish grey, with yellow "fringe"; *Rufa*, burnt sienna, with orange "fringe"; *Succinea*, bright yellow, with orange "fringe"; *Alba*, white, with yellow "fringe"; *Hiberna; Bocagei; Albalatoralis*, black and white, with orange "fringe"; *Bicolor; Reticulata*, yellow ochre, with redder "fringe" and broad brown patch on "shield" and back, tentacles black; *Fasciata*, type form *Brunneo-fasciata*, warm brown, dark on sides, paler below, "fringe" yellowish; *Marginella;* and *Maculata.*

The eggs are laid in great numbers in all seasons of the year, sometimes as early as January, under stones, wood and dead vegetation; twenty to fifty in batches that hatch out, according to temperature, in from thirty to fifty days. Four types of *Arion* stand apart from *ater* in certain important characteristics:

I. *A. subfuscus* is smaller, measuring from two to three inches, and does not

EGGS OF SLUG IN TURF.

A YOUNG SPECIMEN OF *ARION ATER* (VAR. BLACK) CONTRACTED IN ANGER.

contract into the hemispherical form when annoyed or at rest. The colour of the body is always darker than the "shield"—whereas in *ater* the colouring is uniform—and the species has no shell. The type form is said to be represented by *A. subfuscus rufo-fusca*, a yellowish-brown animal with dark bands on back and side and curving over the respiratory orifice on the "shield." The favourite food is fungi, these slugs eating the most poisonous kinds of the *Agarics* with impunity.

II. *A. hortensis* is a very familiar slug to all gardeners—far too much so for their equanimity. It is a small variety about an inch and a half in length, and possesses a very tough skin; this being a point discovered by gardeners, who do not proceed upon scientific methods of investigation, but avail themselves of a handy brick. *A. hortensis fasciata* is regarded as the type form, having a dark slate-coloured back and centre of "shield" with black stripes on the sides, and curving the border of the "shield." The "foot-sole" is always orange. There is no true shell, only a few loose granules in the shell-sac. *A. hortensis aurea* is the brightest coloured form, the back, "shield" and "foot-fringe" bright yellow; the sides of the slug are grey. It is most destructive in gardens to lettuce or strawberry plantations and such like; the species is also found in open country. When the gardener resorts to deliberate methods of self-defence, the animal's partiality for beer can be depended upon.

III. *A. circumscriptus* is another small variety said to measure only an inch. It is a slug associated with open country, although a consignment of turf can easily introduce it to the garden, as it inhabits grass fields and wayside land.

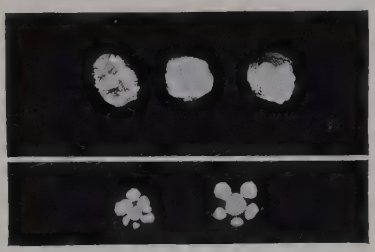
The animal is broader in build and paler in colour than *A. hortensis*, of pale cream colour shading to grey, darker on the back with a distinct black band passing round the body on the sides, the name being derived from *circum* (around) and *scriptum* (marked).

A distinguishing character is the white "foot-sole"—a really brilliant white—and the softer skin as compared with *A. hortensis*. The young slug shows a slight dorsal "keel," but this subsides when fully grown. Variety *A. circumscriptus grisea* is the most commonly known, having pale grey general colouring with sepia banding.

The type has pale brownish-grey back, dark brown banding with orange-yellow sides in the area lying between the band and the cream-coloured "foot-fringe"; the "foot-sole" brilliantly white. The slug is often found under rotting trees and logs, where it makes burrows in the damp soil; it is also found in association with mushrooms.

When resting, the animal takes the familiar *Arion* contracted form, with the "foot-fringe" spread out probably for more secure support. To the touch this slug is extremely sticky, and easily exhausted when exposed to sunlight, when it falls into twisted forms or stiffened unnatural curves.

IV. *A. intermedius*, or, as sometimes designated, *A. minimus*, has few varieties. Compared with *A. circumscriptus* it is smaller, and less striking in colour and markings, the banding being indistinct and colouring paler. The notable characteristic is the curious formation of the skin folds, that when the animal is contracted show as glistening points that sharply refract the light. The outline of the back shows a saw-like edge. The respiratory orifice is placed rather farther back than is usual with the *Arionidæ*. The colour generally a pale yellow-grey, sometimes showing faint bands or without. It is also an inhabitant of open land rather than cultivated, the food entirely fungi. The eggs are laid from August to January, hatching usually in three weeks. The shell-sac exists, but the actual demonstration of a shell is reduced to a thin lining of soft chalky substance.



SHELL FORMS OF (1) *ARION ATER*, MULLER (BATH); (2) *A. HORTENSIS*, FERRUSAC.

The shell seems to be constructed by an excretion from a great number of lime-cells that line the inner membrane of the sac, this organ of the animal having the capacity for collecting and condensing the calcareous substances that become absorbed by it.

One may even suppose that the shell was, in point of fact, a consequence, rather than a determinate purpose—that the lime-secretion being condensed in quantity, became first granular, then consolidated into granules that coalesced into the shelly plate of greater or less density.

Further development necessitated this plate becoming convex upward to accommodate the animal's organism. Instances have occurred where the shell of the slug has worn its way through the skin of the animal.

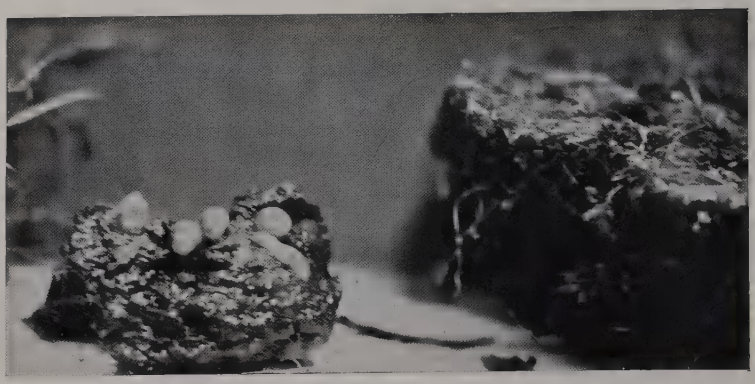
The second branch of the *Arionidæ* tribe, the *Geomalacus*, is represented by one species in this country, namely, *Geomalacus maculosus*, a spotted slug. The species is said to be dying out, with representatives only in West Europe. It is a lichen-feeder, and the general colouring shows a curious conformity with its surroundings when resting on the rocks among the colour splashes of these plants, the back of the slug being black spotted with white, and the sides yellow. The power to contract exceeds that of the *Arion*, for *Geomalacus* coils into a complete ball when disturbed. The respiratory orifice is anterior, like the *Arion*, but the "shield" is considerably larger, being a third of the extended length, and a shelly plate further differentiates the species. The shell is oval and flat, as solid as that of the *Limax*, and quite distinct from the loose granules of the *Arion*. The species has four varieties: the type form, *Geomalacus; G. fasciata*, a pale greenish-grey, with stripes on the back; *G. verkruzeni*, yellow-grey, with white spots on a grey back; *G. allmani*, dark grey, with white spots.

GENUS "AGRIOLIMAX" AND "MILAX" (THE FIELD SLUGS)

These slugs stand apart from the true *Limacidæ* in the coloration, in the invariable absence of the longitudinal banding, and in the distinct character of the milky white slime. They are smaller in size, and show a white, uncoloured ring round the respiratory orifice. The body is flattened on the sides, seen most noticeably when the slug is moving, and "keeled" towards the tail.

The "shield" is a third, or more, of the length of the body, rounded before and behind, and marked with the fine concentric lines of the *Limax* tribe.

The species *Agriolimax agrestis*, subvariety *lilacina*, is a variation on the pale ochre-coloured type form, being a uniform pale grey tinged with a lilac shade; the body is marked with long-shaped blotches of a rather darker shade, the head and "tentacles" darker, whilst the "keel" shows lighter. The white ring that surrounds the respiratory orifice is clearly marked. It is a highly organised member of the slug tribe, and shares the power of adapt-



EGGS OF *LIMACIDÆ* AND YOUNG SLUG ONE DAY OLD.

ability to new surroundings characteristic of the *Limax*.

Owing to its habit of frequenting cultivated land it has become colonized in many countries, ousting the native slug after a time. It is a most destructive slug, moving rapidly in the fashion of the *Limax*. In woods and shady places the pale varieties abound, the darker occurring in the open. The coloration goes through considerable change, passing from light to darker tones in the change of the seasons. A pale cream-coloured animal in the spring becomes a rich brown in autumn, so the exact identification of a variety is complicated by the modifying conditions of time and place.

The illustrations on page 1067 show the shells of *Limax maximus* and *Agriolimax agrestis* in contrast; those of the latter are very beautifully formed little shells of pearly white colour.

Agriolimax lævis is a very small slug of the same species, of uniform chestnut-red colour, having a large "shield" that appears situated in the middle of the body when the abnormally long neck is extended. There are two varieties besides the type form: one mottled brown, *A. lævis maculata*, and a grey and fawn-coloured animal, *A. lævis grisea*.

GENUS "LIMAX GAGATES," OR "MILAX"

This is one of our uncommon slugs, of which the type form is black in colour, though more often represented with us by pale grey or brown.

The species is regarded by some writers as a link between *Limacidæ* and *Arionidæ* on account of the "shield" being granulated in the style of the latter animal. In most other respects it is definitely related to the former class, save in three important departures: (1) The extension of the "keel," which runs the whole length of the back from "shield" to tail; (2) the elevation of the central part of the "shield" into what appears a secondary one of smaller size lying upon it; (3) the markings of the "foot-sole" being chevron-shaped instead of transverse.

The elevated portion of the "shield" is further emphasized by a horseshoe-shaped ring that almost surrounds it. The respiratory orifice is behind the centre of the "shield" border, which is characteristic of the *Limacidæ* and not of the *Arion*.

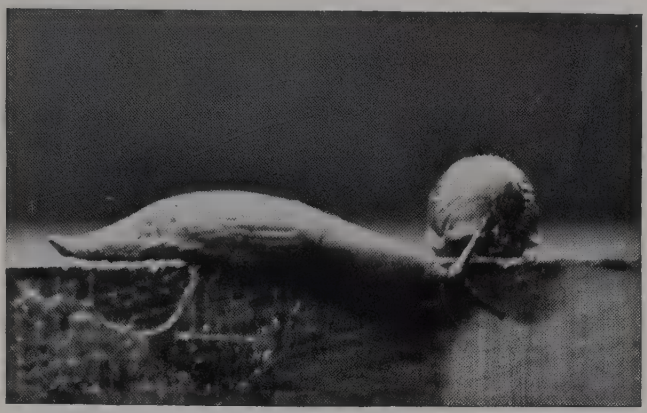
It is a carnivorous species, rarely eating vegetable food, slow in movement, possessing a thick skin; the average life is some years.

Milax gagates is a slender slug with a pronounced dorsal "keel," sharply truncated at the tail. It is a nocturnal species, living below the earth's surface and feeding on decayed vegetable matter, and is also most destructive to bulbs and tubers of plants. The animal changes diet on occasion, preying on small snails and slugs.

The young slug shown on this page was hatched out in captivity, the eggs, five in number, having been found in advanced development in some imported turf. I could not determine the exact variety in so early a stage, save that it belonged to the *Limacidæ*. When touched it contracted into position of *Arion* for a brief space of time, showing a sharply

formed "keel" the whole length of the back; but the "shield" was marked with concentric lines, and respiratory orifice posterior. The colour, a uniform pale grey, lighter on the sides, with darker markings on the "shield," with the "tentacles" a dark slate-grey; the length about half an inch. The movement frequents stiff clay soil in gardens, lying in worm-burrows during the day.

Although I have made no reference to the anatomical structure of the slug tribe, as not being of general interest, the consideration of the mouth of the animal is worth a few words. Unless slugs have been studied in captivity, it may not be



ARION ATER; VARIETY SHOWING BLENDED COLOURING OF GREENISH GREY WITH ORANGE FOOT-FRINGE.

was as rapid a day old as that of a full-grown slug.

Milax gagates, when resting, contracts more into the rounded form than any other British *Limax*. *L. maximus* and *L. flavus* lie curled head to tail in the fashion of a dog, the detached "shield" border lying out in a way suggestive of a dog's ears.

The variety *M. Sowerbii* shows the "keel" paler than the body, most prominent on the back, and disappearing towards the tail. The colouring is grey, tinged with yellow, as small pigmented cells that show as dots; the "keel" is amber-coloured, and the "shield" granulated in surface as the *Arionidæ*. It known that you can distinctly hear them feeding; and watch the deliberate series of circular bites enlarging the gap in a lettuce leaf. Regular sharp little sounds are made with precision at each bite, and with each movement the mouth can be seen opening as a dark cavity between the two curved "lips."

The slug is possessed of what is termed a "lingual ribbon" or jaw plate, that is set with exceedingly fine sharp teeth. The variations between species is determined in exact study of the subject under the microscope, when these jaw and teeth variations from typical form are taken into consideration.

MAUD U. CLARKE.

GRYPHEA INCURVA—ONE SPECIMEN SHOWING OPERCULUM, FROM THE LIAS.

AMMONITES COMMUNIS, FROM THE LIAS.

FOSSILS AND THEIR STORY

By F. MARTIN DUNCAN, F.R.P.S.

With Photographs by the Author

FOSSILS are the pictures wherewith Nature has illustrated her great stone book, the pages of which are the mountains and valleys, the cliffs and seashore, the peat-bog and river channel; pages that are eloquent with the romance of the past history of this earth, and which are ready to yield something of their romance to every intelligent observer.

With the aid of these fossil remains, it is possible to reconstruct many a page of the history of the Earth's past, and to learn what the plants, animals and insects were like that lived during each geological period, and also what climatic conditions prevailed; while perhaps the most interesting and valuable of all, is the fact that by careful studying and comparing these same fossils, we are able to trace the origin, ancestry, and gradual evolution of many of the forms of life which inhabit the earth to-day.

Fearsome, indeed, must have been many of the creatures which lived during some periods of the earth's past; creatures more weird in appearance than any that have been drawn by the facile pencil of that inimitable caricaturist of geological remains, Mr. Lawson Wood; and we may well be thankful that they have ceased to exist. As we gaze upon the gigantic fossil remains of these monsters of the past, we cannot help wondering if such ancient and practically universal myths as the dragon story had not an origin in literal fact, and are the dim echoes handed down from the days of Palæolithic or pre-Palæolithic Man.

It always seems to me very strange why so many people labour under the absolutely mistaken idea that geology is a "dry-as-dust" sort of hobby, and one out of which little or no interest is to be extracted. As a matter of fact, it is one of the most absorbingly interesting hobbies one could wish for. Think for a moment what this term geology means—it is formed from two Greek words, which literally mean earth-science—and you will at once realise what a wide field of interest it covers. It is the science which will help us to understand how every mountain and valley, moorland, cliff and marsh,

FAVOSITES—A FOSSIL CORAL FROM THE UPPER SILURIAN.

has been formed, and it will help us to a fuller appreciation of those vast changes, climatic and geographical, through which the earth has passed.

In "Cliffs and their Story," "Sand Dunes," and "Nature's Masonry" we have gained some insight into the methods which Nature employs in sculpturing and moulding the face of the earth. Now let us turn our attention to the fossils which we shall find imbedded in the rocks of the different formations, and try to piece together the wonderful history of the past. In most of the sedimentary rocks, fossil remains, usually consisting of bones, shells, teeth of animals and the remains of plants, are to be found, and with their aid it is possible to reconstruct the creatures and plants that were peculiar to the formation in which they are found.

Casually glancing over a large collection of fossils, we cannot help noticing that many have a more or less distinct likeness to some of the animals and plants that are still in existence; but examples of exact resemblance are confined chiefly to the newer deposits, and even here are comparatively rare.

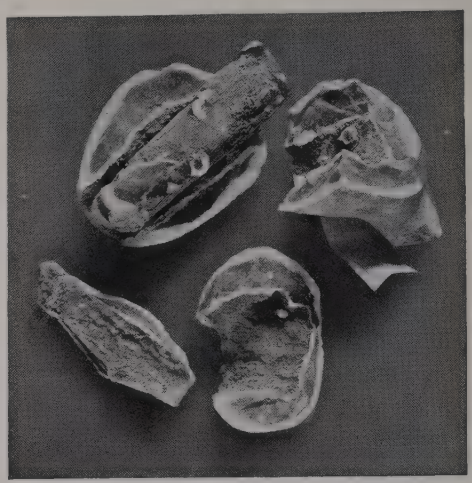
It is very interesting to observe how, in the struggle for existence, it is the simpler forms of life which have persisted with comparatively little change through past geological ages, while the more complex forms of life have either become totally extinct, or have undergone considerable modification; while a closer examination of these fossils will demonstrate and deeply impress the circumstantial truth of Darwin's theory of Evolution. Nor must we forget that it is by the careful examination and comparison of fossil remains that the biologist has been enabled to determine the ancestry and evolution of many forms of life to be met with to-day.

It is impossible, in dealing with the history of the earth, to give any numerical idea of the passage of the ages, and therefore it becomes necessary to divide geological time into periods or formations. These periods have been definitely fixed by the character of the rocks and the fossil remains peculiar to each, and may be divided into three great eras. These three great eras have been given names of Greek origin: the first has been named

NEUROPTERIS—A FOSSIL FERN FROM THE COAL MEASURES.

Eozoic, which means dawn of life, from the Greek *ēos*, dawn, and *zoē*, life—and of the life of this period we have still a good deal to learn; to the second era the name Palæozoic, meaning ancient life, has been given, and is derived from the Greek word *palaios*, ancient; the third era is called Neozoic, which means new life, from the Greek *neos*, new, and *zoē*, life; and emphasizes the dominant character of the forms of life represented by the fossils. To further facilitate the geological record of the history of the earth, each of these great eras is divided into successive periods, while the rocks peculiar to each period comprise a system. During each period slight geographical changes, accompanied by the change or modification of the existing forms of life, took place, and these are used to indicate the limit of an *epoch;* while the great rock-masses, containing the physical and life-history of the era, form a group of strata. Thus the Neozoic era in Britain is divided into two groups of strata, one called the Cainozoic or Tertiary, the other called the Mesozoic or Secondary. The Cainozoic group comprises five geological periods, while the Mesozoic comprises three, and these again are divided into epochs. The Palæozoic era is divided into two groups—the Newer and Older Palæozoic, each comprising three periods; while the Eozoic has one period—the Archæan.

SHARK'S TEETH, FROM THE CHALK.



FOSSIL SPONGE IN FLINT CHALK.

The Archæan or pre-Cambrian rocks, forming the Eozoic group, are the oldest known rocks in Britain, and are now only naturally exposed to view in a few localities where they originally formed very high land, or have become exposed by excessive denudation or great faulting; but in most places they are very deeply covered by the deposits of the newer formations. They have undergone considerable changes, and are still a somewhat ill-defined group. Of the rocks forming this group, the Gneiss is probably the oldest, and it presents the same general characteristics wherever found, although it is not all of the same age, some probably being, comparatively, more recent. According to Professor Bonney, "Gneiss may be, if not actually part of the primitive crust of the earth, masses extruded at a time when molten rock could be reached everywhere near to the surface." Between the Gneiss and the unmistakably sedimentary rocks frequently lie enormous masses of Crystalline schists, sometimes several thousand feet in thickness. No fossils having been found in them, their origin is often difficult and sometimes impossible to determine, and but little has been discovered about them. The upper schists probably represent ancient limestones, clays and sandstones; while the lower Crystalline schists are generally intensely folded and crumpled, and are probably of igneous

CALYMENE—A TRILOBITE FROM THE UPPER SILURIAN.

INTERIOR AND EXTERIOR OF SHELL OF *STROPHOMENA*, FROM THE SILURIAN FORMATION.

origin. All the indications point to a period of stress and widespread volcanic action. Of fossil remains of animal life traces are few and exceedingly doubtful.

The Palæozoic era is one of very great interest, for it is in the Lower Cambrian strata that the earliest well-preserved fossils have been found; and in the rocks of this era have been discovered the fossil remains of many extinct species. The most important fossils confined to the Palæozoic rocks are known as Trilobites, and are the fossil remains of the ancestors of the crabs and lobsters. The name Trilobite refers to the peculiar structure of each successive segment of the animal's body, each segment being divided into three portions or lobes. These creatures had on the chest and tail segments of their bodies, feet adapted for swimming, and gills for breathing; and, from the number of their fossil remains, must have been very numerous. In general appearance, apart from their tri-lobed segments, they are rather like very large specimens of the so-called wood lice—which are really Crustaceans—that live under the bark of old, decayed tree-stumps.

Resting conformably on those of the Cambrian system are the rocks belonging to the Ordovician or Lower Silurian system. From the fossil remains and general character of these deposits it would appear that the geography of Britain, while these rocks were being formed, presented the appearance of a deep-sea archipelago, somewhat like the Malay Archipelago or the Kurile Islands, the islands being chiefly volcanic. Some gigantic Crustacea called Merostomata are found in these deposits, and may be considered an ancestral type of the King-Crabs. Trilobites were also numerous, and the pretty double shells of Strophomena, a Brachiopod shell-fish, which existed during some four geological periods —from the Ordovician to the Carboniferous period.

It is in the Silurian deposits that the first fossil remains of the fishes and land plants appear. The pretty little trilobite called Calymene was not uncommon, and Sea Lilies (*Crinoids*) abounded. Corals were very numerous, and must have formed considerable reefs in just the same manner as they are doing in the tropics to-day. Amongst the Corals characteristic of this period, are the Honeycomb (*Favosites*), the Chain Coral (*Halysites*), and Omphyma. Amongst the fossil Hydrozoa, the beautiful little Monograptus belongs to the Silurian formation. The ancestors of the Cuttle-fish and Nautilus of to-day were well represented in the Silurian seas, their shells coming down to us most beautifully preserved.

To the enthusiastic fossil-hunter the Silurian deposits of Shropshire, North Wales, the southern part of the Lake District, and the southern Highlands of Scotland offer a rich harvest of most interesting specimens.

In Scotland, South Wales, and Here-

VOLUTA—A BEAUTIFUL FOSSIL SHELL FROM THE BARTON CLAY.

fordshire an interesting set of rocks come above the Silurian formation, and are known as the Old Red Sandstone. The rocks of the Old Red Sandstone apparently were formed in great inland lakes not unlike the Lake Superior of to-day. Hugh Millar has made this formation famous by his charming book entitled, "The Old Red Sandstone." How strange in appearance the creatures which dwelt in these great lakes must have been, cannot be better described than in the words of Hugh Millar himself: "Creatures whose very type is lost, fantastic and uncouth, and which puzzle the naturalist to assign them even their class; boat-like animals, furnished with oars and a rudder; fish plated over, like the tortoise, above and below, with a strong armour of bone, and furnished with one rudder-like fin; other fish less equivocal in their form, but with the membranes of their fins thickly covered with scales; creatures bristling over with thorns; others glistening in an enamel coat as if beautifully japanned. All the forms testify of a remote antiquity—of a period whose fashions have passed away."

We now come to one of the most important and interesting geological periods in the Earth's history, the Carboniferous period, during which our coal-fields were forming. It was an age of luxuriant vegetation, in which the land was covered with vast forests of most extraordinary appearance, composed of giant tree-ferns, Club-mosses, and Horse-tails of majestic proportions, and great monkey-puzzle trees (*Araucarias*). From our British Coal strata no less than 130 species of ferns have been obtained, yet to-day there exist in the whole of Europe but some sixty-seven indigenous species. Of the giant Club-mosses, whose trunks frequently exceeded fifty feet in length, some forty species have been discovered. Their descendants, the Club-mosses of to-day, are most abundant in tropical climates, are diminutive in size, and usually creep on the ground, though a few, like the *Lycopodium densum* of New Zealand, stand erect and attain a height of nearly three feet. The Horse-tails (*Equisites* and *Calamites*), whose stems were five inches or more in diameter and eight feet in height, grew in dense companies on the sand or mud flats, in much the same manner as their dwarf descendants of to-day. In the sluggish rivers and swamps dwelt weird amphibious animals of predaceous character, ranging in size from a few inches to some eight feet. Fishes swarmed in the waters of the period; many were armed with powerful conical teeth, while others possessed massive palates adapted for crushing or cutting their food. In the estuaries vast numbers of a species of fresh-water mussel existed, their shells, somewhat resembling the form of their modern representatives. Lace-wing flies flitted through the dark

RHYNCHONELLA, FROM THE OOLITE FORMATION.

HOPLITES LAUTUS—A FOSSIL NAUTILUS FROM THE GAULT

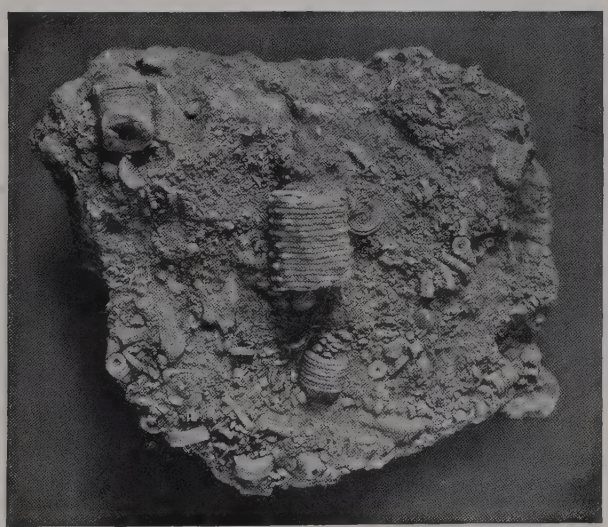
glades, and were captured in the snares of strange spiders; while scorpions, centipedes, and leaf-insects crawled amongst the rank vegetation. Indeed, the Coal measures and Carboniferous Limestones abound with fossil remains, the oval nodules of hard clay which are found in the coal seams yielding a rich harvest of fossils.

The next most interesting formation to the amateur geologist is the Lias, which has yielded an enormous number of most important fossil remains, all in a wonderfully perfect state of preservation. It was an age of gigantic aquatic reptiles, the Ichthyosaurus and Plesiosaurus, creatures measuring from eighteen feet to thirty feet in length; of wonderful fishes, and countless mollusca. The ancestors of the modern Cuttle-fish and Octopus were exceedingly numerous, and their well-preserved fossil remains abound, more than 130 species of Ammonites and nine species of Nautilus having been found; indeed, the different zones of the Lias are characterised by particular Ammonites. Vast numbers of a species of oyster or Gryphæa are found in the Lower Lias, which is sometimes in consequence called Gryphite Limestone.

The Oolite and Purbeck beds afford a large number of most interesting fossils, for in the latter formation have been found the fossil remains of several species of warm-blooded marsupials. The plants of the Purbeck beds consist chiefly of ferns, conifers, and cycads, and all point to a tropical or semi-tropical climate, for the Araucarian pines which are now living in Australia and its islands, together with marsupial quadrupeds, are found in the same way to have accompanied the marsupials in Europe during the Oolitic period. The Oolites yield beautiful examples of the fossil "Stone Lilies" or Crinoids, which are not plants, but related to the Star-fishes. They are of very great interest, not only on account of their beauty, but also from the fact that though so numerous in past geological ages, the genera have gradually dwindled, until but a few members of this ancient family, like Pentacrinus and Comatula, survive in the seas of to-day.

The Upper and Lower Cretaceous, or chalk formations, include many remarkable fossil remains. The earliest fishes with internal bony skeletons occur in Cretaceous rocks, together with the Iguanodon, a gigantic reptile that walked on its hind legs, and the strange Pterodactylus, or Winged Lizard, which measured sixteen feet six inches from tip to tip of its outstretched wings.

F. Martin Duncan.



ENCRINITIC LIMESTONE COMPOSED OF THE STEMS OF STONE LILIES (ENCRINITES).

LEAVES AND FLOWERS OF BERBERRY.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—V

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE JUNIPER THE BERBERRY THE TAMARISK

THE JUNIPER

THIS is a conifer. Though to a popular view its fruit would seem to be a berry, being neither conical in shape nor cone-like in structure, but, on the contrary, round and succulent, yet its true character is that of a cone. It is, however, the only cone of its kind.

The habit of the Juniper shows considerable variation. It may be a small tree. It is usually a shrub, upright with ascending stems, or low and flattened with spreading and even prostrate branches. It has remarkable power of adaptation to varying conditions of position and altitude, soil and climate. With us, on the whole, it seems to prefer the dry, sunny, and open slopes of the chalk hills, where its scattered tufted bushes are frequently a marked feature. Lacking the spiked branches of the Gorse, it is, however, well protected against browsing animals by the abundance of its stiff and sharply spinous foliage. Its slender stems, irregularly but profusely branched and twigged, with close-set multitudinous evergreen leaves, make it an ideal shelter for numerous small birds at all seasons. The bluish or greyish green of its general aspect, very particularly noticeable in early

summer when the fresh shoots abound, affords a pleasant variation amongst the greens of Nature.

The bark is scaly, furrowed in age, and when peeling off hangs in ragged strips. That of the branches is reddish brown in colour, passing to greyish brown. The buds are very small, green, without protecting scales, being tiny tufts of young, pointed leaves. The leaves are long and narrow, boat-shaped, hollowed out above, keeled beneath, hard and rigid, with a sharp needle point at the prow. The edges and the under part are green, but the concave part above is lined with silvery wax, which serves to give to the whole shrub its characteristic tint. These leaves are arranged in groups of three, radiating from the twig in a single plane. Each group is separated from the preceding by only a small space of bare stem, and each group has its leaf insertions alternating with those before and after, so that the defensive points at the tips of the leaves are presented in turn in every direction. The leaves remain attached for about four years. In the winter they assume a reddish tinge.

The flower-clusters, each no larger than a very small bud, are inconspicuous. Those bearing pollen are, as a rule, on different shrubs from those which produce fruit. Both may be found in autumn near the middle of the current year's shoots, at the points of junction with the leaves. They do not open till the following spring. The pollen flower-clusters, mere conical groups of stamens, with diminutive scales and no petals, are yellowish. The fruiting flower-clusters, also without petals, are true cones, having overlapping scales. These are pale green in colour, and show at the tip three erect whitish points, indicating the parts which fructify. The fruit, a berry-like cone, takes two years to mature. It is at first green, but on ripening becomes a bluish black, coated with a waxy bloom. It is almost stalkless, being close down on the twig. What in ordinary cones are dry enclosing scales have here been converted into a succulent juicy casing, attractive to birds, which are the agents in the dispersal of the three enclosed seeds. Fruits in their two stages—those of the last and those of the present year—are

JUNIPER BUSH.

FRUITS OF JUNIPER.
Some in their first year, others in their second year of growth.

to be found on the shrub at the same time.

There is a dwarf variety of Juniper, which has shorter and less prickly leaves. This is found chiefly on the mountains of North Wales and of Westmorland, and in Scotland.

THE BERBERRY

This shrub, also known as Barberry, is a doubtful native. In a wild state it may be found in hedges, thickets, and open woods. It was much more common formerly than now, having been sedulously uprooted of late years because of the harbourage it gives to the fungus, in one of its life stages, which causes "rust" on wheat. It is an elegant shrub with numerous arched branches. In early summer these are adorned with ordered clusters of golden bell-shaped flowers. In the autumn there is a scarcely less beautiful array of brilliantly coloured fruits. It is effectively protected with spines.

The brown winter twigs are zigzag. At each bend in the zigzag is a blunt brown bud, and immediately beneath the base of the bud are usually three slender, stiff, sharp spines, two of which project to right and left, whilst the third points forward. These are frequently depressed, serving, not only for protection, but to some extent also as grapnels, giving support, like the prickles of a bramble, when pushing through other vegetation. These spines are modified leaves. The

FLOWERS OF TAMARISK.

leaves, tufted on the short shoots, scattered on the long shoots, are oval, pointed at the base and tip, rather stiff, edged with tiny but distinct spines. The midrib is well marked, but the secondaries are obscure, breaking up almost immediately into a decided network of smaller veins.

The flowers are complete with stamens and pistil. They have six petals and six calyx leaves, all of a rich golden yellow, forming a kind of double cup or bell. A very perfect device secures cross fertilisation by the agency of insect visitors. The six stamens, lying prone in the cup of the petals, radiate from the base of the central columnar pistil. These stamens at the base are highly sensitive. Here are the honey glands. An insect seeking the nectar inevitably touches a stamen, which instantly springs up, striking its pollen box against the visitor, whom it dusts with pollen. The insect, bee or beetle, may or may not be startled away. In either case it carries some pollen to the next flower visited, which goes through a like performance. So the pollen is conveyed from flower to flower.

The berries are long oval, or oblong; juicy, and of a bright orange-scarlet colour when ripe, attractive to birds. They contain two or three seeds.

THE TAMARISK

This is the shrub of the sandy wastes and the seashore. It has been naturalised here, and is found chiefly and in some abundance round our southern coasts. Growing under conditions which other shrubs are unable to endure, in sheer sand, drenched by sea mists or by driven salt spray, exposed to drying winds and the untempered sun-heat, yet thriving withal, it has been largely utilised to make hedges about the reclaimed shore lands, and for ornamentation on the seaside promenades. Its habit, whether as shrub or small tree, is loose and feathery. Its long, slender, withe-like branches give it some resemblance to a willow, but the leaf system reminds one rather of that of the cypress or the heath.

On old stems the bark becomes deeply fissured, and in colour is a yellowish brown. That on the branches is marked with fine lines, is red in colour, varying to purple or brown. The branches curve over at the ends. The leaves, which are minute, scale-like, of triangular shape, and grey-green in colour, entirely clothe the slender shoots, to which they are pressed closely, overlapping at the edges after the manner of tiles. Transpiration, as is very needful under the conditions

BERBERRY BUSH IN FRUIT.

THE TAMARISK.

of growth, is accordingly reduced to a minimum.

The flowers, complete with stamens and pistil, are individually small. They have each five pink or whitish petals. They are densely grouped in long cylindrical clusters, occupying nearly the whole length of the slender lateral twigs on which they occur. As these floral twigs are themselves usually clustered towards the ends of the branches they become very conspicuous, resembling rosy feather plumes. Their colour is deepened by the red tips of the many prominent stamens, of which there are five in each small flower. The petals remain attached till the fruit is ripe. The fruiting clusters bear a striking resemblance to the fruiting catkins of a willow. Each fruit in the long fruit-cluster is a three-valved capsule, and contains several seeds. Each of these seeds is crowned with a plume of fine silky hairs serving in aid of its dispersal by the wind.

Very abundant on the sandy or marshy sea-coasts of the Mediterranean, and along the western shores of Spain, Portugal and France, its range with us is along the sea border from Cornwall to Suffolk. Though apparently often semi-wild, it was probably always planted in the first instance, its ready growth from cuttings affording facility for quick increase wherever required. This and several varieties are often found in gardens further inland, where their feathery branch sprays and rosy plumes of flowers make a distinctive and welcome addition to the shrubbery border.

HENRY IRVING.

EGG-CASES OF SOME COMMON FISH

By S. F. MAURICE DAUNCEY

With Photographs by A. F. DAUNCEY

MOST people are acquainted with the eggs of the Cod—the Cod's roe—as they are seen at the fishmonger's during the early months of the year; but there are forms of fish eggs, or rather fish egg-cases, to be found on the beach, which perhaps the majority of seaside holiday-makers hardly recognise.

Almost at any season of the year we may pick up a light yellowish mass composed of small capsules which, at first sight, may be taken for a piece of coarse sponge. If it be found above high-water mark it will most likely be somewhat brittle; but if it have only just been washed up it will be very sponge-like to the touch. These little capsules are the egg-cases of the Whelk.

The spawning season is during the autumn, and each capsule, when extruded, contains some five hundred to six hundred eggs. As bunches of the capsules vary in size from a small apple to a melon, the number of eggs produced annually by one fish will be seen to be enormous. It probably runs into millions.

About half a dozen or so of the eggs in each capsule generally begin to develop before the rest, and these "young barbarians" at once start feeding on their less wideawake brothers and sisters. By means of this food the young fish is able to live within the egg-case, where it was hatched, until its shell is formed, and then during the spring it sallies forth to fare for itself.

SKATE'S EGG-CASE.

WHELK'S EGG-CASE.

"Jack Tar" is a resourceful man, and when soap fails him he will use these capsules to wash his hands with. They have accordingly been called "sea-wash balls."

Another common egg-case, though perhaps not so common as the Whelk's, is that of the Skate. This case is oblong in shape, and has a short arm at each corner. It is often found partly covered by seaweed and zoophytes.

The name "Skate's barrow" has been attached to this case, owing to the resemblance it bears to a hand-barrow. When picked up in the summer it is, as a rule, empty, or only filled with sand and small pebbles. If examined, one end will be found to be broken open, and it was through this crack that the little Skate got away.

DOG-FISH EGG-GASE.

The egg-case of the Dog-fish is not such a common object, and the reason is that it is provided with very long and elastic tendrils—if we may borrow a botanist's word. These readily fasten on to seaweeds and other objects, and once so moored the case cannot easily be washed away. The material of which it is made is of a horny nature, and, when dry, if it is tapped with the nail it gives very much the same sound as does a hollow horn.

The case is constructed so that the end nearest the fish's head will open upon the slightest pressure from within; and, being of an elastic material, will at once close again when the fish has passed out.

BIRD LIFE OF THE LEIGH WOODS, SOMERSET

By HEDLEY VICARS WEBB

With Photographs by R. PRATCHETT, Bristol

THE Gateway of the West seems an appropriate name for that wonderful canvas of Nature, the Avon Gorge and Leigh Woods, which has made Clifton so famous, and attracted lovers of the beautiful from all parts of the country. The spring of 1909 has seen an added interest taken in this unrivalled demesne of Nature, for by the generosity of a member of the house of Wills, the woods clothing the Avon Gorge on the Somersetshire side have been secured to the citizens of the Metropolis of the West and their descendants for all time. The glory of May-time is rapidly passing into the leafiness of June as we cross the Suspension Bridge and reach the roadway skirting the edge of the cliffs, with the Nightingale Valley two hundred feet below. To look "down" on the tree-tops is an experience not always obtainable, but how beautiful is here the effect, with oak, ash, birch, larch, fir, wych elm. white beam, spindle, sycamore, etc.,

in the full glory of reawakened spring! The neighbouring church of St. Mary's is the centre of a fairyland of natural beauty, when the silver birches in thousands are putting on their graceful foliage, and not even the magic wand of an Oberon or Titania could produce anything more charming. What more fitting home could be found for our native songsters, now joined by a numerous company of warblers from over the seas? From dawn to sunset the woods resound with their songs. The cheery little Chiffchaff sings unceasingly from the tree-tops, where he is busy searching for insects; while his cousin, the Willow Wren, is equally active in the same pursuit. Another relation, the Wood Wren, is not far off.

These three diminutive migrants are the very life and soul of the woods, for they are always busy, always happy, and always singing; and their light and graceful movements are fascinating to watch. Being so closely allied in size and olive-green plumage, they are somewhat difficult to distinguish, except by an expert observer. The song, however, is distinct in each case. The notes of the Chiffchaff form a constantly repeated strain of "chiff, chaff, cheep, cheep, chap," the musical tone of which readily distinguishes the song from the metallic "see-saw" notes of the Great Tit. The Willow Wren fully deserves to be known as the "canary of the woods," its song consisting of a series of liquid, rippling notes, chiefly of a descending scale order. To an attentive listener it appears that each bird varies his phrases not a little, but all have the characteristic tone. A beautiful effect is sometimes heard when several Willow Wrens are in song at the same spot. Each bird will commence its song immediately after a rival, and the rapid succession of their descending strains produces a kind of "chiming" most pleasing to hear.

The most noticeable feature of the Wood Wren's song is that it begins slowly with a "chit, chit, chit," and only a slight raising of the pitch, and then gradually

THE VALLEY OF BIRD LAND.

A FAVOURITE HAUNT OF THE NIGHTJAR

quickens until at the close the notes are lost in an ecstasy of confused chattering, the body of the singer shivering with the movement.

It is somewhat unfortunate that the woods only contain one small pond, and this, situated close to the roadside, has been included in the purchased portion of the estate. A pond or pool is always a favourable spot for observing bird-life, so standing here, perfectly still and partially hidden, we watch for arrivals, who come to drink or bathe. Twenty species or more can frequently be counted in the space of half an hour. From the bushes and trees they drop quietly to the edge of the water — the handsome Redstart, the wary Nightingale, the Blackcap, the Garden Warbler, the Great and Blue Tits, the graceful Long-tailed Tit, the Chiffchaff, Willow and Wood Wrens, the irrepressible Robin, the boisterous Blackbird, the cautious Thrush, dusky Hedge Sparrow, sprightly Chaffinch and Jenny Wren.

No bird-lover can possibly be contented till he has made the acquaintance of the Nightingale and its song; and the Leigh Woods give such an opportunity during May and the early part of June, for this peerless songster loves the seclusion of the bush foliage. The bird does not, however, resent observation if you remain quiet and still. Its presence is soon discovered by hearing a very rapid "wheet, wheet, wheet" frequently repeated, and these notes are so arresting that they at once command the attention of a listener. Snatches of song then generally follow. The full song is sometimes to be heard at midday, when the sun is bright and warm; but late in the evening twilight, when other songsters are silent, is the time for hearing the marvellous melodies to perfection. Beautiful as the song of Philomel is, it is not wholly melodious. Many of the strains are composed of a sometimes toneless, sometimes harsh repetition. A simple note uttered very rapidly will be continued for two or three seconds. The

THE BRIDGE VALLEY ROAD IN THE AVON GORGE.

next strain may be a rather fierce-sounding "r-r-r-r," ending abruptly, to be followed by a phrase exactly resembling a Blackbird's rattling alarm, but having a better tone. There is one feature, however, which raises the character of the song above all others, and that is the magnificent crescendo. This is particularly noticeable in the strains composed of long notes.

The male Redstart is one of the most handsome of our spring visitors, his white forehead, black head and cheeks, contrasting well with the slaty blue of the back and chestnut of the breast. The fiery tail is at once seen when he flies off. He and his more sober-coloured spouse are very partial to the oak tree, in a hole of which may be found the nest.

From the top of a hawthorn the Blackcap pours forth its beautiful song. This warbler is considered by some a Nightingale secundus. The male bird is recognised by its black head and slaty plumage. The female has a brown cap. The rapid variations in pitch of the Blackcap's song are remarkable, high notes and low notes and medium ones being taken with such quick alternation that the ear can hardly follow. The singer is rather shy, and often darts off when observed.

WHERE THE WILLOW WRENS WARBLE.

Though perhaps a less common bird in the woods than the Blackcap, the song of the Garden Warbler closely resembles that of its relative. The songster itself is also of similar plumage, but without any distinguishing cap. The pitch of the Garden Warbler's full notes is often very low for so small a bird, and equals the lowest notes of the Blackbird.

An unobtrusive little bird is our dusky friend, the Hedge-sparrow, or Accentor. Being a soft-billed bird, and therefore not a real sparrow, he fully deserves more attention than he usually gets, for his song, though short, is a sprightly little warble, rapid and with numerous turns. Its nest is always a happy find; the beautiful blue eggs seem to reflect the azure of the sky, and contrast charmingly

with the green foliage surrounding the nest.

The Tit family is well represented in the woods. The Great Tit is constantly uttering his "see-saw" strain, and is easily distinguished by his size. The Blue and Cole Tits are as tiny and active as mice among the branches. The former can be recognised by the prevailing blue colour, and it has a narrow dark streak down the middle of the breast. The Cole Tit is of a much duller plumage, and has a small white spot on the nape of the neck. The Long-tailed Tit is the most delightful of all the species, and can be readily known by its tiny body and very long tail. The general colour at a distance is black and white, but at closer quarters a rosy colour is seen on the back and flanks. Very fortunate are we when the nest is discovered. It is one of the marvels of bird architecture, generally placed in a thorn bush, dome-like in shape, and completely closed except for the small entrance hole near the top. The interior is lined with myriads of tiny feathers.

WHERE PHILOMEL SINGS.

The smallest of European birds, the Golden-crested Wren, though not uncommon in the woods, may easily escape notice, as it haunts the tops of trees, preferring firs and larches, where it diligently searches for its insect food. In plumage it is of a yellowish olive-green, with the golden crest on the head.

The Nuthatch and Tree-creeper haunt the Nightingale Valley all the year round. The former is a most cheery little fellow, always busy, and always happy. He climbs up or down the trunks of trees with equal facility, and you may hear and see him in the fall of the year, hammering away at a nut which he has placed in a crevice of the bark of a tree. Just now he is as busy as a mason, plastering up with mud the entrance hole to his nest, until it meets with his approval as to size and security for his family. The Nuthatch has a few song cries, all of which are loud and distinct. One of these is a clear whistle, slurred upward in the inter-

val of about a sixth—just such a whistle as one would give to call a dog.

No less interesting is the silent Tree-creeper as he climbs the boles spirally, searching unerringly every tiny hole for insects, and giving one the opportunity of noting his dark brown back with pale spots, and the silvery under-parts.

The Finch genus is fairly numerous. A short full whistle reveals the presence of the handsome Bullfinch, which can also be recognised by its heavy lilting flight, and the conspicuous white patch over the tail. The song consists of little more than the whistle given on two or three notes. The Greenfinch has now put on its brightest attire of yellow and green, and the somewhat coarse "wheeze" which ends its song is heard almost incessantly from all parts of the woods. The Chaffinch is more numerous than its relative, and the familiar song, together with the well-known call-notes "pink, pink," meet one at every turn.

That most interesting nocturnal bird, the Nightjar, finds a good retreat in the woods, for bracken abounds, where he delights to hide during the day. If flushed by anyone, he simply flies a short distance and drops again into the undergrowth. He is sometimes discovered lying "along" a branch of a tree, a method of perching peculiar to himself, which serves admirably to hide his identity from the branch itself. At dusk he throws off his lethargy, and becomes extremely active in his pursuit of moths, etc.

The twofold shout of the Cuckoo is often heard in the woods, although this visitant prefers more open country, flying from tree to tree and frequently "calling" for a mate when doing so.

Woodpeckers and Jays can always be seen or heard. By stalking the laughing call of the Green Woodpecker, you may get a peep at him as he ascends a tree. The Great Spotted Woodpecker also makes his home here, nesting regularly in the woods.

Gulls and Jackdaws are inseparably associated with the Avon Gorge. Nearly all the former belong to the Black-headed species. They are frequently to be seen in large companies at low tide, walking over the muddy banks and showing plainly their red legs and beautiful plumage. At other times they swim on the water as gracefully as ducks. Sometimes, too, they rise together high up over the Gorge, carrying out very remarkable evolutions of a circling nature and never colliding one with the other. The Daws are seen all the year round, flying to and from the inaccessible rocks on the Clifton side, where they nest, happily and unmolested, in the springtime.

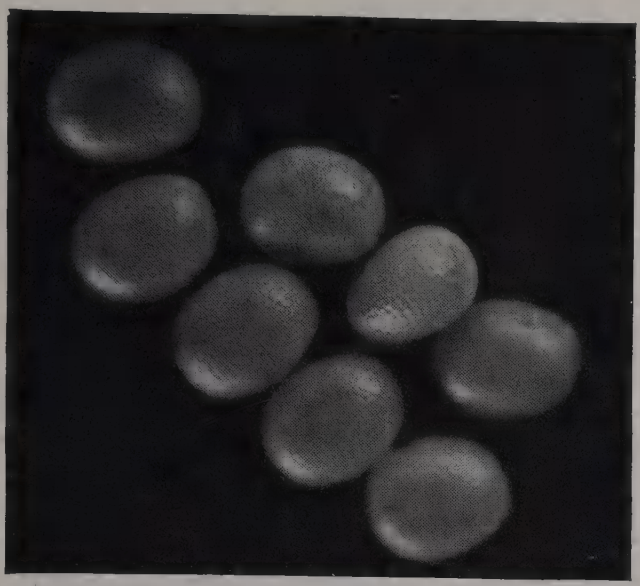
That graceful and useful bird of prey, the Kestrel, is occasionally seen hovering over the Gorge, giving an opportune moment for looking "down" on his mottled brown plumage as he rises and falls below you. The quivering wings, the inclined head and fan-like tail cannot fail to arrest the attention, and you watch every movement until the Wind-hover returns to the woods. I here wish to urge an earnest plea for the Kestrel and other useful birds of prey. Nature has herself provided these Arabs of the air, and it is to man's advantage that this provision should be respected. Yet how frequently are both Kestrel and Owl—the very best possible friends of farmer and agriculturist—relentlessly trapped and shot for their pains in keeping down vermin!

Retracing our steps from this ramble in Nature's domain, we linger by the edge of the cliffs near the bridge to enjoy the scene on the Clifton side of the Gorge. A remarkable wealth of arboreal foliage clothes the slopes of the Bridge Valley Road. You listen to the Thrush and Blackbird engaged in a vocal contest for the mastery until the Nightingale defiantly breaks in upon them. The Cuckoo continues to "call" and the Nightjar commences his persistent "churring." Willow Wrens warble unceasingly, and nothing seems to repress the trill of the Robin. The Gorge has become shrouded in a mantle of blue. A spring tide fills the Avon. The last Gull is going homewards to the Severn Sea. Later a full moon will rise upon this wondrous scene. Here and now will the Nature lover realise, if he has not already done so, that the old City of the West possesses a fairyland of natural beauty, pulsating with life, and rich in the mystical music of springtime.

H. Vicars Webb.

OLD OAK TREES.

From a Water-Colour Drawing by C. E. Flower.



EGGS OF THE MAGPIE MOTH.
(Magnified 20 diameters.)

THE MAGPIE MOTH AND ITS PARASITES

By JOHN J. WARD, F.E.S.

Author of "Life Histories of Familiar Plants," "Some Nature Biographies," "Minute Marvels of Nature," etc

Illustrated from Original Photographs by the Author

AMONGST those insects that work mischief in the gardens and fruit farms, the Magpie, Currant, or Gooseberry Moth (*Abraxas grossulariata*), as it is variously called, holds a very prominent place. The British Board of Agriculture have, indeed, found it necessary to issue a leaflet giving methods of prevention from, and remedies for, the attacks of this destructive insect.

The moth appears about midsummer, and it frequently flies during daylight. Its wings are white, bearing numerous deep brown or black spots and blotches, together with some yellow markings ; consequently, it is a very conspicuous insect. It derives its popular name, Magpie Moth, from the bold markings of its wings, while its other familiar names have reference to the plants upon which it works so much havoc during its larval period.

Some of the eggs of the moth are shown in the first illustration magnified twenty diameters. They are somewhat oval in shape, and their shell structure bears a silvery appearance and is beautifully reticulated with a delicate pattern, which is revealed by means of a magnifying lens, as the illustration shows. Although the tiny eggs have so attractive an appearance under the lens, it is, nevertheless, from these little objects that the fruit-

grower's trouble arises. When the female moth has once deposited her numerous eggs amongst the leaves of gooseberry or currant bushes, it becomes a difficult task indeed to prevent the foliage of the bushes from being more or less completely stripped later on.

In ten or eleven days after the eggs are deposited, the little caterpillars emerge, and at this stage are so small that they escape notice. Their feeding at this period does but little harm, and towards the end of August, or early in September, they give up feeding and spin bits of leaves together on the ground beneath the bushes. Later, falling leaves afford them further protection, and so they spend the winter months.

The fruit-grower has probably failed to observe the advent of his enemy, but it is in the following spring that he detects the mischief that is being done to his trees. Just when the branches are becoming clothed with new leafage, numerous dark-coloured caterpillars may be seen biting out the hearts of the buds, and should these destructive larvæ be neglected at this stage, the branches will often be completely denuded of their leaves, and the fruit crop for that season ruined.

So ravenously do the caterpillars feed after their winter hibernation that often by the first week in May they are full-fed. Some full-grown larvæ are shown on p. 1107. They are of a cream colour, striped along the sides of their bodies with orange-yellow, and bearing large black spots along the back. Indeed, they are coloured very similarly to the moth which they eventually become.

Now these contrasting and conspicuous colours play a very important part in the economy of this insect. Both the moth and the caterpillar make no attempt at concealment, but expose themselves boldly before their enemies; they rely entirely on their gay and conspicuous colouring to warn off their foes. While many insect species depend for protection upon a more or less perfect simulation of their surroundings, whereby they become inconspicuous, the Magpie Moth, throughout all the stages in its development, takes the contrary course, and flaunts its colours before the eyes of its enemies, thus making itself as conspicuous as possible.

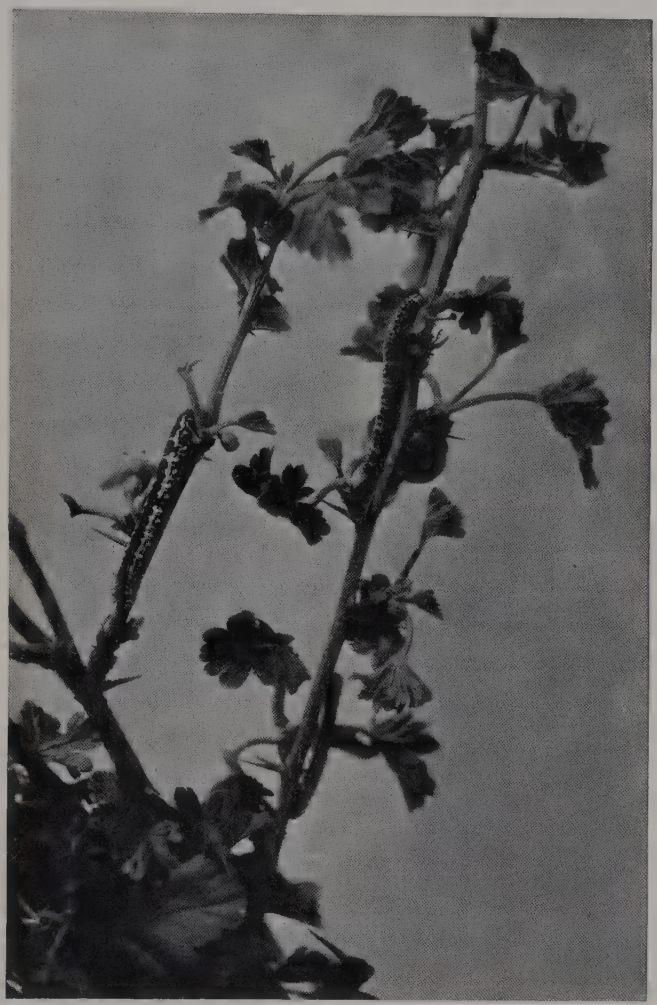
THE ICHNEUMON FLY SEEKING FOR CATERPILLAR VICTIMS ON WHICH TO DEPOSIT ITS EGGS.

Such showy colours are generally associated with nauseous and distasteful properties, and insectivorous animals are consequently warned from making an attack upon species so coloured. A frog or a toad, seeing one of these caterpillars in motion, may snap it up greedily, but will quickly reject it again, and nothing will thereafter persuade the frog or toad to touch another similar larva. Probably that first attack was wholly the outcome of inexperience.

This caterpillar is also distasteful to birds, spiders, and other enemies, and being thus enabled to escape from the attacks of some of the most formidable foes that prey upon caterpillar species, it naturally thrives apace and often becomes a serious pest, owing to its destructive work while feeding.

It happens, however, that when-

ever an organism outstrips its natural foes, and becomes too dominant in the struggle for existence, new enemies arise to check its ravages and restore the lost balance of power. So it occurs that, although in some seasons we may find the leaves of currant, gooseberry, or plum trees being destroyed by innumerable larvæ of the Magpie Moth, it does not follow that there will be numerous moths later in the season, and that the pest will thrive and become still more abundant the following season. Probably by the time the moths should have developed, Nature will have taken measures to correct the defect in her working scheme that has allowed an organism too decided preponderance, and will have checked it so thoroughly that, during the season that follows, the predominant species may become quite scarce. We will now, then, observe how any excessive development of the Magpie Moth is suppressed.



FULL GROWN CATERPILLARS OF THE MAGPIE MOTH AMONGST GOOSEBERRY BRANCHES.

Last autumn in the writer's garden some gooseberry bushes were badly attacked by the larvæ of the Magpie Moth, and the caterpillars fed boldly in the bright sunlight, in their characteristic manner. Now, one could not approach these bushes during sunlight without finding swarms of what were apparently common house-flies buzzing round and congregating about the branches and amongst the leaves. This fact led to an experiment.

Some of the full-fed caterpillars were collected up and provided with some dried stems on which to form their cocoons. In the upper part of p. 1108 two of the larvæ are shown in their delicate silken cocoons, in which, when they have moulted their skins, they change to the pupa or chrysalis stage ; while below, on the right, another has completed its change into a chrysalis, its shrunken caterpillar skin being seen near it. In the lower part of the photograph on the left is seen another cocoon in which appears the shrunken skin of a caterpillar and three comparatively small chrysalides of oval form.

The chrysalis of this moth is banded black and yellow, and probably, like both the caterpillar and the moth, it derives protection from its bold colouring ; indeed, the very frail character of the cocoon, in which the chrysalis is clearly exposed to view, points to that conclusion.

ABOVE ARE TWO CATERPILLARS ALMOST READY TO BECOME CHRYSALIDES. BELOW, ON THE RIGHT, IS THE COMPLETED CHRYSALIS. ON THE LEFT APPEAR THREE CHRYSALIDES OF THE PARASITIC TACHINA FLY.

In favourable weather, at the end of from three to four weeks, the moth is ready to appear, bursting its chrysalis skin and the silken threads of its cocoon, and appearing upon the branches to shake out the folds from its wings (p. 1109). It does not follow, however, that such a successful issue always takes place, as the experiment previously referred to made clear.

It was obvious that something was amiss in the cocoon in which the three small pupæ appeared. In several other examples under observation the same thing occurred, and, after seventeen or eighteen days, from each of these little chrysalides there emerged what appeared to be a common house-fly. A closer glance at these insects revealed the fact that although they closely resembled house-flies, yet they were really only near relatives of those familiar insects: a species, indeed, whose habits are very different.

These flies belong to the family *Tachinidæ*, and are commonly referred to as Tachina flies. There are numerous species, most of which in general appearance resemble house-flies, or blow-flies. To man they are most beneficial, as in the larva stage they prey largely upon caterpillars which feed upon his crops.

Whenever a gooseberry, currant, sloe, or other bush, on which numerous caterpillars are seen to be feeding, is surrounded by a buzzing swarm of flies, some of which are continually alighting and moving amongst the leaves, it will be found that these are Tachina flies. Their function is to seek out plump-bodied caterpillars, and, by means of a gummy substance, to fasten their eggs to the skins of the larvæ. From

THE PARASITIC ICHNEUMON FLY SEEKING FOR CATERPILLARS.

the egg there hatches a small maggot which penetrates the skin of the caterpillar, and feeds internally on that insect until its development is complete. The larva develops a ravenous appetite, but the nourishment that it absorbs all goes to benefit its internal boarders. Finally, when the caterpillar should change into a chrysalis, it usually has about sufficient strength left to construct its cocoon, which is the closing scene of its life. The parasites within then consume the vital parts of their host, and this final meal usually suffices to complete their development, whereupon they break through the skin of the caterpillar that has reared them, and quickly change into pupæ with the silken cocoon, as shown in the lower example on the left of p. 1108.

THE MAGPIE MOTH JUST EMERGED FROM ITS CHRYSALIS.

Not infrequently amongst the bushes where Tachina flies are abundant the parasitic Ichneumon flies will also be found. These are hymenopterous insects, possessing, like wasps and bees, two pairs of wings a feature which readily distinguishes them from the dipterous, or two-winged, Tachina flies. The Ichneumon flies may be recognised by their active movements amongst the leaves, their long antennæ continually twitching and quivering with excitement as it were, while they seek for caterpillar victims on which to deposit their eggs ; for although they belong to an entirely different group of insects to that of the Tachina flies, yet their method of attacking leaf-eating caterpillars for egg-depositing purposes, and the subsequent development of the larvæ, is very similar.

The Ichneumon flies, however, have probably attained a much higher evolution than the Tachina flies, for the latter will attack caterpillars of various species indiscriminately, and also the larvæ of beetles, humble-bees, wasps, and insects of other orders ; and not infrequently they deposit more eggs on a larva than its substance will provide for their maggots ; or they will even place their eggs on a caterpillar that is about to moult its skin, with the result that the young grubs perish when hatched from the eggs.

The more highly evolved Ichneumon flies, however, rarely make such errors ; indeed, a particular genus or species of these parasites will sometimes prey upon only a certain family of insects, so that a caterpillar may have its special Ichneumon ; or, if it is an abundant species, it may have several kinds of Ichneumons, which patronise it as their special host for the rearing of their young.

From some of the pupæ of the Magpie Moth under observation in the experiment previously referred to, the Ichneumon species illustrated on pp. 1106 and 1108 emerged, one fly only from each moth pupa. The slender curved waist attached to the lower part of the thorax, the long and pointed antennæ, and the fore-wings bearing a dark-coloured triangular spot, are all features which show well on p. 1106, and which should be observed by all amateur entomologists desirous of distinguishing these insects.

When one has realised the significance of the persistent attacks of these parasites combined with those of the Tachina flies, it becomes plain that the larvæ of the Magpie Moth, although protected by their colours from many dangerous foes, have yet even more formidable ones to contend with on which their warning colours exert no influence. So it happens that a mighty host of leaf-eating larvæ may quickly become converted into winged Ichneumon and Tachina flies instead of moths; then it may occur that Ichneumon or Tachina flies are in excess, and then their enemies in turn appear in abundance. Thus the balance of power in Nature ever needs and receives readjustment.

JOHN J. WARD.

THE COLE TIT

By ALFRED BRAILSFORD

With Photographs by the Author

OF all our feathered neighbours who make their homes in our woods and gardens the family of Tit-mice are, perhaps, the most fascinating. With their knowing looks and pretty colouring, not to mention the business-like way they have of looking for their food, they afford endless pleasure.

The smallest member of this family, the Cole Tit, feeds chiefly on insects, but may be coaxed into our gardens in the winter by means of a suspended Brazil nut, almond, cocoanut or piece of fat. A bird will come near, perch on the suspending string, hop to the top and bottom rims of a cocoanut—the end of which has been sawn off—twisting and turning himself upside down, right way up or sideways, and performing gymnastic exercises and balancing feats which any variety entertainer might be envious of.

THE COLE TIT.

All the Tits may be attracted by these means in the winter, but as spring draws near their visits become less frequent, and in the middle of April they cease, when the birds betake themselves to the woods and orchards to rear their hungry families.

The Cole Tit likes various kinds of holes for breeding purposes. Small drain pipes, rat or mouse holes in banks, holes in trees and stone walls, are all used in turn, and in these the pair of birds build their nest of dried grass and moss, neatly lined with a soft layer of feathers. On this downy bed the hen lays from six to ten beautiful little eggs speckled all over—more thickly at the larger end—with rusty red spots.

After about ten days from the laying

of the first egg, the hen will be sitting. The cock is now all hurry and bustle, turning somersaults round the twigs of a neighbouring oak, peering into all the crannies for hidden treasure, taking his burden to his sitting mate, and receiving many kind acknowledgments.

The young are soon hatched, and the cock has to redouble his efforts, for he has not only to feed his mate but six or seven hungry youngsters. This lasts only a day or two, however, when he is joined by his mate. As the young grow the parents increase their exertions, and there are always open beaks asking for more!

When they happen to be near the nest together the hen will shuffle her wings and ask her mate in the plainest way for the delicacies he has brought.

ENTRANCE TO THE NEST.

Earlier in the year he would have taken notice of these appeals—or rather, would have been so assiduous in his attentions that the appeals need not have been made—but now he takes no notice, his extra duties absorbing his time and attention.

They bring from four to six caterpillars about every two minutes to the nest.

Let us say they work ten hours in the day and bring five caterpillars each time, we get some idea of the huge quantity the young consume. Multiply this by about thirty days and by the number of broods reared by all the insect-eating birds, and one may then imagine the enormous good done by them. How grateful our farmers and gardeners ought to be!

After a time the young become fledged, and leave the nest to follow their parents into the world of wood and sunshine, quivering their wings when food is brought, and twittering a grateful thanks in return. Later they become grown birds, independent of their father and mother, performing acrobatics in the topmost twigs on their own account, and will, no doubt, come to our cocoanuts and almonds in due season.

There is some confusion between the Cole Tit and his near cousin the Marsh Tit, and it would be well to mention here that the Cole Tit has white-barred wings and a white nape, whereas the Marsh Tit has neither of these marks.

ALFRED BRAILSFORD.

COMMON GORSE.

HOW TO KNOW THE SHRUBS GROWING IN BRITAIN—VI

With Notes, descriptive and photographic, for their Identification in all Seasons of the Year

By HENRY IRVING

THE GORSE AND THE BROOM

AS do the Laburnum and the so-called Acacia, the Gorse and the Broom both belong to the Pea-flower or Pea-pod tribe. In both the leaves as such occupy a very subordinate position, being either, as in the Gorse, converted to other forms and uses, or, as in the Broom, to a considerable extent suppressed. Yet the plants show more or less green the whole year round, so that they may roughly be classed among the evergreens. The flowers, which are a golden yellow of varying depth, have five petals, the arrangement of which may be best seen in those of the Broom. At the back is a single erect petal, the standard; next are two petals placed horizontally with their inner edges almost in contact, the wings; and beneath these two others joined above and below along their whole length, forming a closed boat-like structure, the keel, which encloses the vital

SEED PODS OF COMMON GORSE.

organs. There are ten stamens and a single pistil.

THE GORSE

Other common names are Furze and Whin. We have two varieties—a larger, the Common Gorse, which may grow to a height of eight or ten feet, and the Dwarf Gorse, rarely exceeding two feet. There is also a small allied plant commonly known as the Petty Whin, which, however, is not a Gorse but a Genista. This, at first glance, is so like the Dwarf Gorse that some description of it will be given and points of distinction noted.

The sentiment that kissing is in season during all those months when the Gorse is in bloom, points to the fact that some flowers of Gorse may be found in nearly every month of the year. Yet this is based on somewhat of a misconception. The Common Gorse may come into flower in November, showing odd spikes of bloom all the winter through, but the full blossoming time is in February or March onwards to the end of May or early in June.

During the following months all the brilliance of the Gorse is absent, only the fresh green of the new growing shoots changing gradually into the sombre tint

PETTY WHIN, SHOWING FLOWERS, PODS, LEAVES AND THORNS.

BROOM.

of the hardened spines, amongst which are the rather untidy-looking clusters of pods in their brown calyx-sheaths, darkening as they ripen. But in June, and it may be in July, the Petty Whin is in bloom, bridging the space of intervening time till the Dwarf Gorse is able to take up the tradition. Then the bright gold gleams beside the purple heather bloom, affording one of the most effective of Nature's contrasts, and, incidentally, justifying the faith of lovers in the truth and fitness of their ancient saw.

The Gorse practically has no leaves; these, as already mentioned, have been converted to other forms and uses. There is evidence that the ancestral form of leafage was that of the trefoil, a compound leaf consisting of three distinct leaflets. The early leaves of the seedling are of this form, though these are immediately succeeded by simple ones, narrow, gradually stiffening into spines. On the mature plant, apart from these spines, no vestige of a leaf remains larger than a minute scale.

In the course of its evolution the Gorse has adapted itself to the endurance of excess of heat and drought. Its compound leaves have been changed to simple ones; these have narrowed to the spinous form, reducing evaporation to a minimum. So the Gorse is able to grow and flourish on the dry heath, exposed to the full glare of the sun. Here another necessity has arisen, that of protection against browsing animals. So these narrow leaves have hardened into spines, stiff and sharply pointed as a shoemaker's awl. Every projecting twig also has become pointed, itself a true thorn, ringed round with outstanding spines, sharp and strong. So the Gorse is armed cap-à-pie, leaving no part defenceless. Yet these hardened spines and thorns are directly due to the condition of dryness wherein the Gorse now flourishes. If seedlings be grown in a continuous moist air, as under a hand-glass, it will be found that, though in the first year, through sheer force of habit, a few shortened spines will appear, yet in succeeding years, so long as the state of moisture is maintained, there will be none—only soft, fleshy leaves. As is often the case with plants adapted to withstand drought, every part of the Gorse is densely coated with minute hairs forming a velvety pile. Twigs and branches are furrowed, and, like the spines, are green in colour.

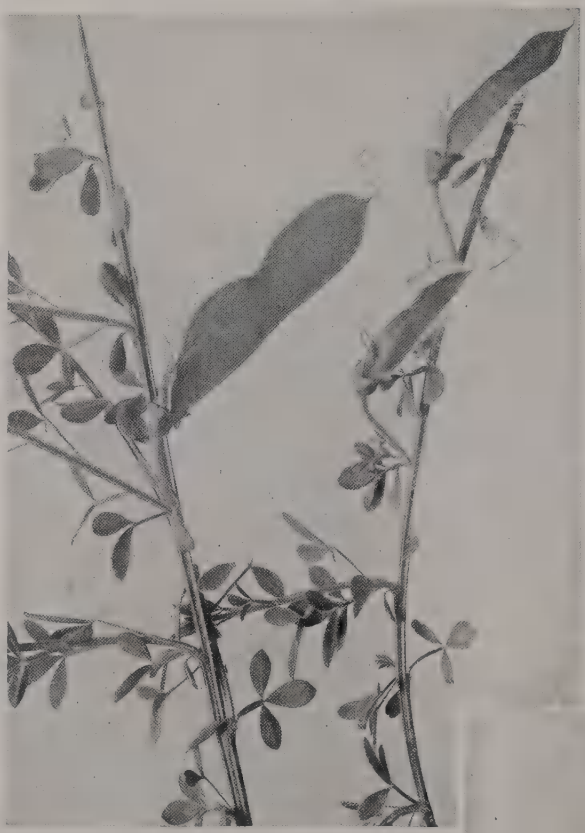
The flowers grow singly or in pairs at

the junction of the spines with the thorn-twigs, and, being somewhat crowded together in the upper part of the branches, they form handsome spike-like clusters. The colour of the petals is a golden yellow, of the calyx yellow also, but modified by its dense coating of greenish or brownish hairs. The calyx, not quite so long as the petals, is divided to the base having the appearance of being jointed like a bivalve shell, opened to contain the flower. As the pod forms the petals shrivel, whilst the two halves of the calyx change to brown. The pod, which is only a little longer than the calyx, is also densely coated with hairs, grey-green changing to brown. It contains about five olive-coloured seeds, hard and polished. These by the drying and sudden splitting and twisting of the pod, accompanied by a sharp report as from a miniature pistol, are thrown far.

The *Dwarf Gorse* may be regarded as merely a reduced variety of the Common Gorse, though its season of flowering is in late summer and autumn. Its thorns are smaller and more slender. Its flowers are smaller and of a richer golden yellow, best seen and most effective in contrast with the associated heather purple. The calyx, equal in length to the petals, is all but hairless. Spines, thorns and stems are velvety and green, like those of the Common Gorse.

The *Petty Whin*, also known as the Needle Greenweed or Needle Genista, has very much the habit of the Dwarf Gorse, but its branches are more straggling. It grows also in similar situations, on dry heaths or moors. It flowers in June, and, occasionally, again in August or September. It has narrow lance-shaped leaves, but those on the flowering shoots are broader. It is entirely free from hairs on the leaves and stems. It has true thorns, but these do not branch as a rule. They are found mainly on the upper part of the stems, and are fine and sharp as needles. They are bent slightly backwards, perhaps with a view to securing better support amongst neighbouring growths. Thorns and stems are brown. The flowers in appearance are more like those of the Broom, though much smaller, displaying plainly the arrangement of the petals as standard, wings and keel. The petals are yellow. The calyx is green and hairless, is only about one-third the length of the petals, and is deeply divided into two parts, the upper part being again divided showing two teeth, and the lower part also showing three teeth. The hairless pods are broad and inflated;

DWARF GORSE.



SEED PODS OF BROOM (IMMATURE).

the persistent calyx, in comparison, is minute.

This is one of the class of plants that as *planta genista* gave to our Plantagenets their emblem and cognomen.

THE BROOM

This besom-like shrub is found generally in rather dry and waste places. It is a frequent inhabitant of steep railway banks, making there a brilliant display in its season of flowering. It has stiff ascending green stems and branches, ribbed and wiry, but there are only a few leaves. The lower leaves are usually compound, having three leaflets, and are attached by short stalks; those higher up are often simple, more lance-shaped, and without stalks. On some branches the leaves are reduced to mere scales, or are obsolete. The green stems have, in part, taken over the function of the leaves. The flowers, solitary or in pairs, grow out near the ends of the long shoots, where they are combined into long clusters. Their butterfly-winged petals of bright yellow render them very conspicuous. Like those of the Gorse, they secrete no nectar, but supply an abundance of pollen, which is eagerly collected by bees.

By an ingenious contrivance, whilst the bee is filling its pollen baskets from the five short stamens placed centrally in the keel petals, a slight explosion takes place. The long pistil shoots out from the tip of the keel, like a piece of released watchspring, and rubs its stigma over the bee's back. Nearly at the same instant,

FLOWERS OF BROOM.
Three of the flowers have exploded.

but just after, the five long stamens follow suit, dusting their pollen on the same spot. So the bee carries away more pollen than it knows of, some of which is taken up by a similar action of the pistil of the next flower visited, and cross fertilisation is achieved. After the explosion, which ruptures the flower, the petals do not recover their position, but leave the remainder of the pollen exposed, free to any kind of insect that may come for it. But no bee will ever take the slightest notice of a ruptured flower. The pods of the Broom are flat, compressed, and fringed along either edge with hairs. They contain several seeds which, when ripe, are flung out by the sudden splitting and twisting of the pod.

HENRY IRVING.

NATURE "IN TOWN"

CITY TREES

By ARTHUR SCAMMELL

THE writing of an essay on the subject of Nature in London would seem, at first sight, an example of the art of making bricks without straw, for, be it noted, the City proper, the "square mile," is our field, and we may not even step over the border into Gray's Inn to visit London's only rookery, nor go into the Embankment gardens to hear the thrush which sings there within the shadow of the Hotel Cecil.

And yet, though we have pushed Nature somewhat out of our sight, she is with us all the time; the rain falls in our streets, and the snow; and, in St. Paul's Churchyard, at any rate, it is possible to feel the force of the wind; half the day the fresh water flows down from the hills through our City, and half the day the sea water pushes it back; and everywhere the air, with patient unseen hand, is hiding seeds and germs innumerable, bidding them lie till time and chance bring the hour for life and growth.

Myriads perish and are swept away, but to some the hour comes; let a cistern leak upon a paving-stone in a back yard, and soon the stone will be green with moss. Pull down a house in the winter, and by next autumn the ruins will have become a garden; so quickly does vegetation spring, and so rankly does it grow, one may, casting the thoughts forward, imagine this "hot huddle of humanity" succeeded by a dense jungle, and see Lord Macaulay's New Zealander hewing his way with an axe to his seat on the ruins of London Bridge.

For centuries after its foundation there were probably pastures within London's walls on the north side, whereon cattle might be grazed in times of siege; and when, in mediæval ages, the monastic orders, the nobles, and other wealthy founders set up their establishments, the new buildings were always surrounded by large and fertile gardens.

And as long as London houses were the homes of Englishmen, the gardens remained; but minds seem now to be arranged in watertight compartments, so that the man who cannot dine or sleep unless surrounded, or at least backed, by his own "grounds," cheerfully passes most of the daylight hours of his life in a wilderness of asphalte and massed buildings.

However, the birds of passage in their flight over the City may yet look down upon a green islet here and there in the

Photograph by Pictorial Agency.

TREES AT GRAY'S INN.

sad grey waste ; and not all of the birds pass on : year by year the ring-doves come back to the Bank of England, not to draw their April dividends, but to build again their love nest in the old lime tree that leans across the Bank's garden.

This place is surely the unique example of the *hortus inclusus*—" a garden walled round," indeed, with walls ten miles thick. Strange that the centre of this world-mart, the inner sanctum of the Temple of Mammon itself, should be—a garden ; that this city of money-makers should bear in its heart of hearts this tender green spot. A little quiet nook where mornings are fresh and dewy, where flowers bloom, living ropes of creepers festoon the walls, and flickering lights and shadows dapple the ground ; where the music of rustling leaves, and the sweet odour of blossoms, are shaken from drooping boughs, and the ripple of falling water mingles with the cooing of the dove ; and where the Bank clerks may beguile the long summer afternoons by watching from the windows the mother bird, as, " with fond endearments," she teaches her fluttering young ones the use of their wings.

A restful noonday haunt is the Tower, with its surrounding gardens ; much frequented of working men, who sit at ease and smoke after-dinner tobacco. The sparrows would seem, by force of constant association, to have adopted human modes of life, and to strictly observe the dinner-hour leisure. However urgent may be the season's duties—nest building, feeding and educating the young, or what not—the sparrows always seem to be given over to idleness at this time of day ; picking up, none too eagerly, stray crumbs, lazily trimming feathers, or, more commonly, simply lounging.

The gardens are pleasantly original in design and cultivation : the conventional order, lawn, flower bed, shrubbery and gravel, is confined to the private garden of Trinity Square—where may be seen, by the by, the very largest trees of the City. For the rest there is a steep bank garden on the north and west sides of the buildings, with an unusually varied and thriving array of trees ; the ash, so rare in London, wych and common elms, sycamores and flowering cherries, with black poplars that atone for their ungainliness by their great size ; much homely underwood, elder, lilac and privet, and

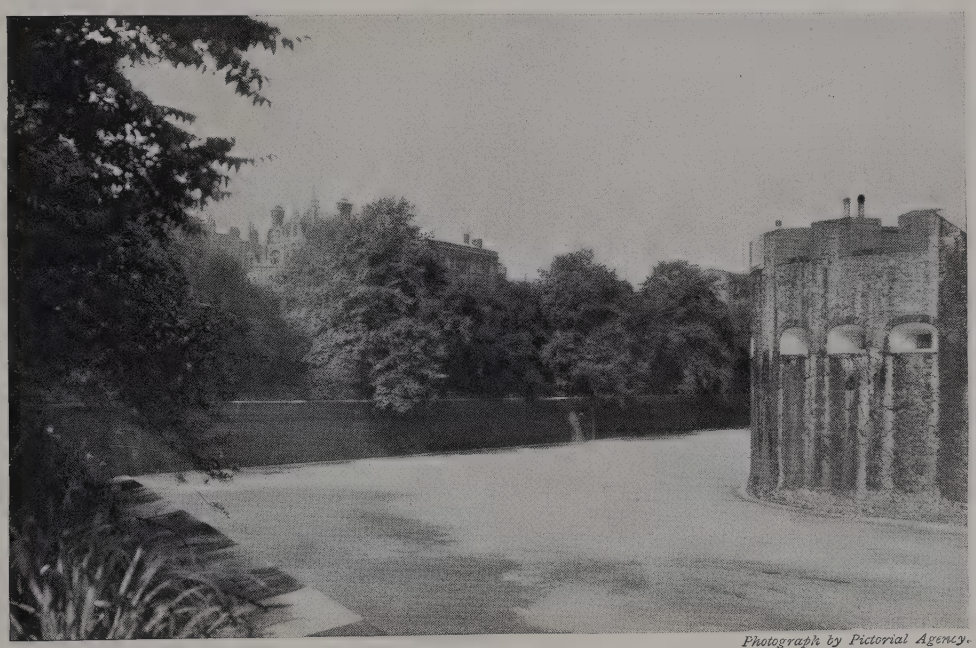
annual and perennial flowers, self-sown; and, not less welcome, some of those well-known familiar weeds that push with such an easy confidence into the most exclusive garden circles.

Still more agreeable, perhaps, are the moat gardens on the south side, between the buildings and the river, for these are cultivated in the country or vegetable-cum-flower-border style. Lozenge-shaped beds, edged with irregular tiles, or bits of old coping-stone, and filled with an irregular setting of old-fashioned flowers—larkspurs, wallflowers, and tulips, pæonies and stocks, cabbage roses, madonna lilies and hollyhocks—with a hedge, and paths innocent of gravel, and growing little bunches of grass on their own account; whilst close by may be a heap of well-dried manure, a rhubarb bed, and a series of thriving plots of parsnips, cabbages and all manner of "garden stuff," with a long screen of scarlet runners in their season. Butterflies hover about the cabbages, and a stray bee hums its way to or from the flower borders. Perhaps there may be a scent of broad beans in flower; and I can well fancy the dock labourer, lately from the country, meditatively regarding these matters through the smoke of his pipe, and wondering whether, after all, life had been so very bad back there in ——shire.

Pigeons sit in a row upon Traitor's Gate; and the old grey masonry, trailed over with vines, wistaria, and virginia creeper, forms a picture of mellow and peaceful age. Time and change have worked their beneficent will, subduing the defiant strength of the fortress, and the cruelty of the prison, and turning the field of blood into a garden.

Moving westward, one passes through Seething Lane and Hart Street, a region given over to the immortal memory of Mr. Pepys. There is the very gateway by which he was wont to enter the old Navy Yard; but one glances in vain now into the back regions for any green spot as a reminder of the garden—the garden where Mr. Pepys buried his money in the time of the Fire, and where afterwards he raked the grass and sifted the mould in the dead of night to find it again.

Of the many trees and greens of the Central City, one can only speak in passing. There is St. Michael's Alley, where I once saw, of all strange City sights, a haymaking—regular swathes cut with a scythe, and then turned and



Photograph by Pictorial Agency.

TREES AT THE TOWER OF LONDON.

Photograph by Pictorial Agency.

CHARTERHOUSE GARDENS.

tedded, and, for aught I know, stacked. It must be admitted, however, that I never saw the rick.

Most of the trees owe their preservation to their connection with the Church; they have "taken sanctuary" in the churchyards. Eminent amongst these is Wordsworth's Wood Street Plane, that used, before the devastating saw was laid to its branches, to stretch its hands out over the two little dusty houses "erected at ye sole costs and charges of St. Peters, Cheape: Ao. Dni. 1687," and fill a gap in the Cheapside buildings with green leaves. Stationers' Hall Court is a blank and stony place, but how is it transformed in summer by the lofty tree which roofs it in with green!

Close at hand lies the cloistral seclusion of Amen Court, where decorous old houses are draped with creepers, and where the grass seems younger and greener for the Cathedral sobriety all around. The largest tree, though apparently healthy, leans and droops with a languorous grace; and I love a leaning tree, one which, following not too hardly the strenuous *ad astra*, chooses to love the world, the green earth which is its mother and ours, and will stoop to listen to the whisper of the grass, and to toy with the lowly flowers of the field.

The charm of monastic calm possesses still the old garden of the Charterhouse; the garden which has witnessed many years of peace, and one of bitter tragedy. The walls are crumbling as old walls should crumble, but against them "the fig tree puts forth her green leaves, and the vines give a good smell." Old mulberry trees are there, and young walnuts—proper ornaments for ancient and courtly places; and a lovely sward, that makes a smooth green coverlet for the narrow beds of Priors and Canons long asleep.

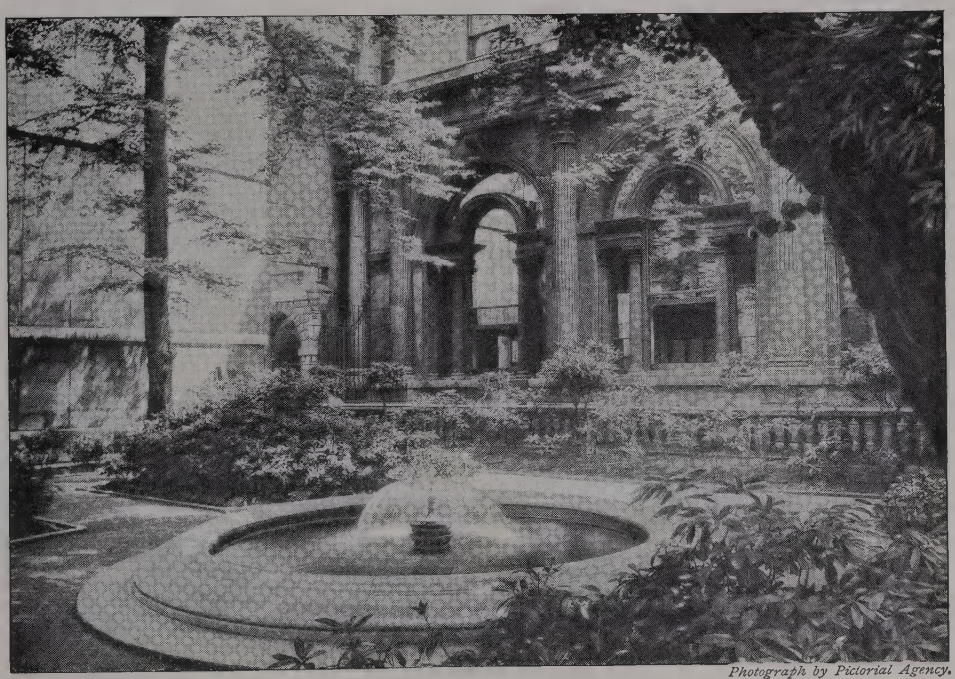
Londoners are proverbially careless of the sights of London, and because the trees are always with us we hardly look at them, and the unspeakable debt which is owed to the plane, as the tree of London, is rarely acknowledged, nor any general meed of admiration paid to its serviceable grace. Some, indeed, there are who depreciate this good friend and citizen; who call it ungainly, coarse and "weedy"; who make ungracious comparisons, and refer to its invaluable characteristic of bark shedding as an untidy habit. Those who thus disparage the plane have surely failed to notice some of its special and

exclusive beauties; as, for instance, the peculiarly rich and elegant effect seen in the budding season of the tree, when last year's tassels, the swelling leaf buds, and the tiny velvet balls of the new blooms thickly stud the crooked twigs, showing an exquisite fretwork against the April sky. Neither do they know the plane in its proper environment of the country, enjoying pure air, sufficient space, and a generous soil.

I have seen on the banks of the Mole a plane tree that seemed too good for this world; such an one rather as might flourish by the waters of some fabled Holy City, bearing miraculous fruits and healing leaves. Trunk, branches, and foliage were all tinged with gold, as though perpetual sunshine were upon it. There are plane trees, too, of almost equal beauty at Moor Park, just outside Stella Cottage. Likely enough Stella and the trees were young and gay together.

Most of the City trees are cared for, and in their measure may be said to thrive; but not all. Hidden away in dark sunless courts, stunted and misgrown for lack of space and light, encumbered by their own dead branches, fouled with smoke and dust, they huddle round the grimy walls of the old church, if church be left—sometimes a tower only, or a warehouse that has usurped the church's place; with both feet in the graves of London's forgotten dead, these sorry fugitives still make a show of life, and have their time of budding and leafage, and at their worst can give a little grace even to the uncomeliness of a London court.

These are the weaker brethren; and the stronger and happier are not far to seek. But to my mind there is something of pathos in the life of all City trees, divorced as they are from all the conditions necessary to arboreal well-being; for a tree planted in the City is already condemned to an untimely death. It may be an exaggerated fancy, but when I look at these brave doomed ones, I am sometimes reminded of the gladiators of old Rome. For our pleasure are they placed in the deadly arena, and gallantly do they bear themselves in the face of day; but in the quiet of early morning, or at night when the moon shines and fresh breezes stray even into City streets



Photograph by Pictorial Agency.

BANK OF ENGLAND FOUNTAIN.

and courts, I can fancy the trees, with bowing crests and waving arms, murmuring their mournful greeting, *Ave! Ave! Morituri te salutant!*

But there is no need to close upon this subdued note. The trees are not all dead yet, and in these days of parks and gardens, when not only do men seem alive to the value of open spaces as "lungs," but also have a tender and civilised regard for things beautiful and venerable; now, when so much of our talk is of forestry, we may well hope that for trees as well as men there is a good time coming. I have never seen better-shaped and healthier saplings than the young mulberries of Fountain Court, nor do the older trees that shadow that memory-haunted spot show any signs of diminished strength. Daily each of the Embankment planes stretches its fingers a little nearer towards its sister tree. Many of us may see them all join hands and make continuous bands of green along the noble street. Our grandchildren may perhaps see the branches meeting across the way.

Photograph by Pictorial Agency.

FINSBURY CIRCUS.

Of these trees, and of the Temple Gardens close by, we have had no space to write, nor of those of the other Inns of Court. We have passed by St. Paul's Churchyard, and the trees that cluster round the burial place of Milton; and the avenue at St. Botolph's, Bishopsgate, and many another spot where grass springs and trees put forth their leaves for the perpetual pleasure and refreshment of dwellers in London.

ARTHUR SCAMMELL.

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